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THE

Photographic Instructor,

FOR THE

PROFESSIONAL AND AMATEUR,

BEING THE COMPREHENSIVE SERIES OF PRACTICAL LESSONS ISSUED TO THE STUDENTS OF THE CHAUTAUQUA SCHOOL OF PHOTOGRAPHY,

REVISED AND ENLARGED,

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EDITED BY

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W. I. LINCOLN ADAMS,

Editor of the PHOTOGRAPHIC TIMES.

WITH AN APPENDIX ON THE NATURE AND USE OF THE VARIOUS CHEMICALS AND SUBSTANCES EMPLOYED IN PHOTOGRAPHIC PRACTICE.

BY

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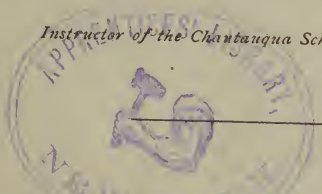
Prof. CHARLES EHRMANN,

Instructor of the Chautauqua School of Photography.



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1888.

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PREFACE.

In the autumn of 1886 the authorities of the Chautauqua University recognized the growing demand for photographic knowledge by establishing a school of photography in accordance with Chautauqua ideas and as an integral part of the great university.

Prof. Charles Ehrmann was chosen the instructor of the school, and *The Photographic Times* its organ. Practical instruction was given during the assembly season, the following summer, at the Chautauqua grounds, and corresponding classes were formed which regularly received the printed lessons by mail, and the written criticism of work sent to Prof. Ehrmann for that purpose, with his advice and suggestions, supplementary to the printed lessons, as the peculiar needs of individual students seemed to require. Provision was made for answering all questions of the students, by number, in a department devoted to that purpose in the *The Photographic Times*, and the school rapidly grew in numbers, influence, and usefulness. It has now become an important department of the great Chautauqua University, with representatives from nearly every State in the Union, with a few even from abroad, and a reputation which has extended to countries beyond the sea.

Local classes for practical instruction at the school's headquarters, New York, during the autumn, winter, and spring, have recently been started, and with entire success; so that now, personal, oral, and demonstrative teaching is given by the instructor of the school during the four seasons of the year, besides the written and printed instruction which is

mailed to a much larger number during the entire twelve months. It was the great practical value of these printed lessons, written as they were by authorities on the various subjects of which they treated, that suggested the advisability of issuing them in the permanent and convenient form which their usefulness seemed so justly to deserve.

Carefully revised, rearranged, and enlarged, they have, therefore, been herein collected, with an appendix added, on the nature and use of the various chemicals and substances employed in photographic practice, by Prof. Ehrmann, and some tables, with other photographic information taken from "The American Annual of Photography and the Photographic Times Almanac." To Prof. Ehrmann is also due the credit for contributing most of the lessons in this book, for he originally wrote the greatest part of them.

Mr. Charles Wager Hull, Superintendent of the School, wrote several of the lessons which form the opening chapters; while Prof. Randall Spaulding, of the Montclair High School; Prof. Karl Klauser, of Farmington, Conn.; Mr. John Carbutt, the dry-plate maker of Philadelphia; Mr. O. G. Mason, of Bellevue Hospital, New York; and Dr. Maurice N. Miller, of the University of the City of New York, deserve the thanks of the reader for the remaining lessons, not written by

The Editor of The Photographic Times.

Editorial Rooms, New York City, June, 1888.

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INTRODUCTION.

The series of lessons which follow this, are written more especially for those who know little or nothing of the charming art of photography, yet who desire to be taught its mysteries by easy, simple methods, leaving for later study the whys and the wherefores, the chemistry and the science. Experience has shown that the amateur and the beginner is far too much inclined at first to ask questions that later on might be well and proper enough; too apt to become an experimenter while yet a tyro; too likely to fill his notebook and his head with conflicting theories and formulæ; not patient enough under simple instruction, and too anxious to do everything at once. These rarely succeed; success attends those who move only so fast as they learn and understand.

To become even moderately successful, photography demands of its votaries certain characteristics, a few of which it is proper the beginner should know of and appreciate, for upon them success depends.

Patience.—Photography being based upon chemical conditions and changes, moves only just so fast; it cannot be hurried. You cannot make a better picture by using a stronger developer, thus gaining time by "hurrying things up;" it is not like driving a nail or sawing a stick of wood. Patience to wait for the right time of day and the right kind of light; patience to look your subject all over, to study it, and find the most pleasing point of view. The resulting picture will then satisfy you, and your labor will be rewarded. We all know of amateurs who should have painted on their cameras, "wholesale only," for they care not half so much for quality as they do for quantity; they can make more pictures in a

day than a painstaking, good working photographer can make in a week, but not one in a dozen is worth the cost of the soda contained in the developer.

This kind of a photographer reminds one of the boy who busies himself on the Fourth of July by blazing away from a revolver, and measures his patriotism by the number of shots he fired.

Order.—This is an absolute requirement. When it is understood that each chemical is used to produce a certain effect when brought into relation with another chemical, it is obvious that the bringing together of chemicals at the wrong time, or in the wrong order, must destroy the work in hand. If, as is constantly the case, various operations are going along at the same time, the greatest care must be used, by continually wiping the fingers, etc., that those solutions which should be kept apart are so kept. Faith in your own efforts is essential to success; not that the methods of instruction or the formulæ to be given are any better than others but that they will enable the student to make as good a photograph as any one can make.

Follow closely and exactly everything that you are instructed to do and under no circumstances adopt or attempt changes; when all has been done as directed, the course is finished, and good work made; then, and not until then, plunge into the boundless field of theory and experiment, and good may come of it.

Those who think they know it all, or know somebody who does; who are not willing to follow as herein directed, will do justice neither to themselves or to the teacher. Last, and by no means the least important requirement is that those who propose to learn the art of photography must love it.

Benefits.—Hidden here and there along every roadside, every mountain stream, every bit of woodland, everywhere, indeed, are beauties not seen by the uneducated eye; but pick up your camera on a fine bright morning, leisurely stroll along, and you will find new beauties at every turn; the more familiar you become with nature's beauties, the more familiar nature will become to you; you will see what you never saw before,

for the reason that you never observed before, you never before searched for her beauties; now that you know of them, you can never find the end. Pages might be written on this benefit alone; it is worth far more than any cost to acquire it.

Another of the chiefest charms of photography is its unselfishness; the pictures made on a morning ramble are not alone enjoyed by the maker, but enjoyed as well by all his (or her) friends; and this cannot be said of all the ordinary pastimes of our time.

Be patient and persevering; maintain absolute order and cleanliness in dark-room and afield; and adhere to one line of the subject until it is mastered, before branching out and experimenting here and there. The result will be a practical skill in the making of good photographs, and an educated eye to see, depict, and enjoy the beauties of nature alone and with your friends.

The Photographic Instructor.

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LESSON I.

APPARATUS.

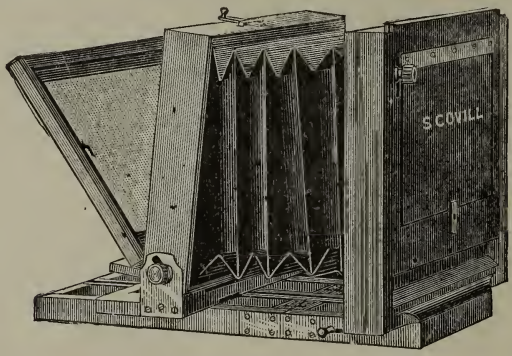
In photography, as in all other industrial and artistic pursuits, certain apparatus, or tools, are needed to produce a picture; some you can buy; others, with but little labor and ingenuity, you can make. This lesson is written to inform you of those tools which you must have, and leaves to your own judgment the purchase of those which, though not absolutely necessary, are, nevertheless, of considerable comfort in carrying forward the various operations through which you are to be led.

The first group of essentials are, of course, the camera and plate-holder, the lens, the tripod, the cloth to be used when examining the image cast upon the ground-glass by the lens, and the focusing-glass.

Cameras vary greatly in their design, and in the means adopted to produce certain necessary conditions. They should be as light as is consistent with the work they have to do, but not so light as to be liable to injury from the accidental blows they are almost certain to receive in out-of-door work.

Cost is too often held to be the first consideration; but good workmanship and simplicity is of greater value to the amateur than the few dollars difference in price.

For all the uses for which they are intended, the "Favorite" and "Waterbury" cameras meet every requirement.



THE "WATERBURY" CAMERA.

The first-named of these cameras is made of light walnut, and the latter of mahogany. They have rubber bellows, folding platform, single swing, vertical shifting front, record slides and side latch for holding the platform rigid. The two features last named are especially desirable. They are as light and compact as substantial cameras can be constructed. The sizes made of this style are for pictures 4 inches by 5 inches; 5 inches by 8 inches, and 6½ inches by 8½ inches. These, with rare exceptions, are the sizes used by amateurs and most beginners.

To those readers who know nothing about cameras, it is well to explain the certain parts named, and their uses. The bellows is that part between the front and back of camera, made to allow them to be moved together or apart, as may be required in adjusting the focus, or the making sharp and distinct of the image on the ground-glass. The ground-glass is that part which in the cut is represented as falling back, and in the place of which, as will be described later on, the holder containing the sensitive plate is secured.

The single swing is that part of the camera to which the ground-glass is attached; it is an adjustable arrangement held in place by a thumb-screw, as shown in the cut, and may be tilted to the front or to the rear, or may be placed vertically. Its uses are many: it serves to equalize the focus, and by proper use the foreground containing the near objects in a pic-

ture is made clear and distinct, or, as photographers say, "sharp."

The vertical shifting front of the camera is that part on which the word "Scovill" is seen; it may be elevated or lowered at will, and is held firmly in place by a thumb screw. On this front the lens is placed; by lowering it, more foreground is brought into the picture; by elevating or raising, less foreground.

The side-latch for holding the platform rigid, is the bolt seen on the platform or bed-piece, and holds rigidly the folding platform.

The platform folds up against the back of the camera, when the back has been pushed forward until it meets the front.

This simple and effective arrangement not alone renders the camera more portable, by reducing its size, but as well protects the bellows from injury during transportation.

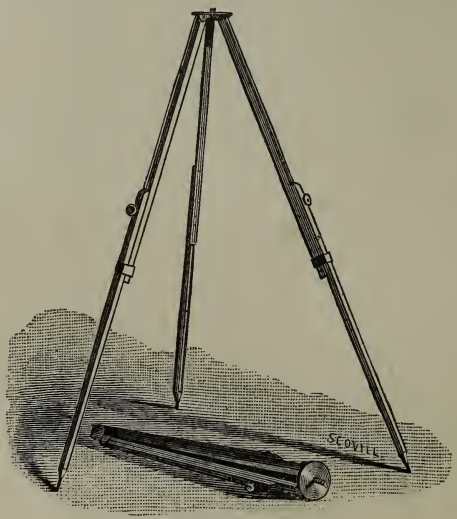
One of the most important factors in the production of the photographic picture is the lens, of which, as in case of the camera, there is an endless variety. Fortunately for the beginner of limited means, the improvement in lenses places within the reach of all, good lenses for very little money. Nothing can surpass, for all the ordinary views of still life, the "Waterbury" lens. It is moderate in price, and, for the purpose stated, meets every requirement. It has good depth of focus (by which is meant that objects near by and distant are both clearly defined), covers a good field, or breadth of subject, and works with fair rapidity.

THE "WATERBURY" LENS AND DIAPHRAGMS.

With it most excellent landscapes and groups can be made in a very few seconds; but to those who wish to include in their work pictures of moving objects, the more expensive lenses must be employed, of which the Morrison, the Wale, and the Gundlach lenses are representative types.

The tripod is the stand on which the camera is placed; it is adjustable, and must be made of well-seasoned wood. When not in use it is folded into compact form, placed in a bag, and is easily carried in the hand. One of the best forms made is that known as the Scovill Adjustable Tripod.

The extension tripod possesses, also, special advantages. It can be set up ready for use quicker than any other, and with less trouble. When placed on uneven ground, the camera it



Scovill Extension Tripod.

supports may be brought to the proper level by simply adjusting the length of the legs, and it has no detachable parts to be misplaced or lost. Without this tripod, valuable time is often wasted, or opportune moments lost in placing the tripod legs, and changing their position, to include just what is wanted in a picture, and to level the camera.

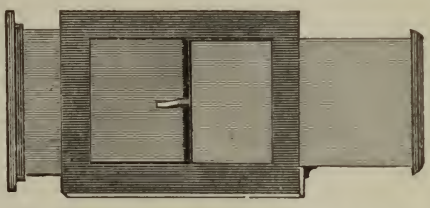
Next in the order of essentials are the focussing cloth and the focussing glass.

The cloth should be about one yard square, of some dark material, and impervious to light; such material can easily be found in any home. Many prefer a cloth made of some waterproof material; this has the two-fold advantage of excluding light, and, in case of a shower, protecting the camera from the rain.

This desirable little instrument is intended to aid the photographer in securing a sharply defined picture on the ground-glass. To most people it is indispensable; the image on the glass being small and reversed, is at times somewhat difficult to determine as to exact sharpness.

Scovill Focusing Glass.

The dry-plate holder (each holding two plates) which the next cut represents, is a device for holding the sensitive plate, guarding it from light, and is so constructed as to be secured upon the back of the camera, in the place occupied by the ground-glass, with slides to be withdrawn when so placed that the image which was thrown upon the ground-glass may then be thrown upon the face of the plate which is concealed in the holder.



The position of the face of the plate is exactly that first occupied by the ground-glass; thus, whatever was seen upon it must now be thrown upon the plate. If the image was "sharp" (a photographic term for clearly defined) on the one, so it must also be on the other.

Of these holders as many are carried into the field as, in the photographer's opinion he will need for the work he has before him.

The articles named—camera, lens, tripod, focusing cloth, focusing glass, and plate-holders—comprise all that is necessary to be carried into the field, neatly packed, as they should be, in proper cases. This, at least so far as the holders are concerned, should never be neglected, for as little exposure of them as possible to light should ever be the rule of the careful photographer.

The next lesson will describe the methods for using the articles which are described in this.

LESSON II.

MANAGEMENT OF APPARATUS IN THE FIELD.

In the previous lesson effort was made to fully describe the apparatus required.

Now let us suppose that we have the camera, with its lens in place in the center of the sliding front where the word "Scovill" appears, the flange of which has been neatly fitted and firmly fastened with small screws; the tripod, the focusing cloth, and the focussing glass. For the present we will leave the plate-holder behind. Picking up the articles named, let us step out upon the lawn, taking position so that the sun will be a little to one side, and behind us. We can hardly expect to secure a good picture with the sun or strongest light directly in front of us, neither can we look for good effects of light and shade (and both are needed) if the light be either immediately over head or directly behind us. More, far more, depends upon the proper selection of the point of view and the direction of the light than many suppose. There is a proper time of day; a proper direction from which the light should come for every landscape; a time when the shadows will so fall as to give the proper effect, for from the shadows in their relations to the strong or high lights, do we get, when properly contrasted, the harmonious effect of the whole. Let us place our camera here. Before us lies a view combining conditions which will teach us the use of our lens with its diaphragms. The first step to be taken is to choose the best point of view. In choosing this we are governed by the following considerations: The sun is to our back and to the right; in the immediate foreground we have a large rustic seat; further along and to the left is a rustic bower covered with vines; in the middle foreground a small pool of water,

still and glassy as a mirror, with several small willows beautifully reflected from within it; further on to the left a magnificent cluster of large trees; beyond, in the distance, and a little to the right, is a pretty villa, and not so thickly surrounded with trees as to obscure its architectural beauties; in front of it a lawn stretches down to the little pool that is situated, as mentioned, in the middle foreground. The light, coming from the direction stated, falls in such a way as to penetrate well into the large forest trees, casting the shadows of the others aslant the lawn, and bringing the projecting angles of the villa into bold relief. This effect of relief—the bold standing out from a flat surface—is nowhere better seen than in a well-painted sign; proper shading, at a proper angle gives to the letters every appearance of being solid, raised from the surface. From this, it must be plain to all that the proper relief can only be produced by proper shading, proper kind of shadows; these it must now be seen, cannot be had to good effect when the light, as before stated, is either immediately over head or directly in front or behind.

Having selected our point of view, place the tripod firmly upon the ground, and upon it fix the camera, passing through the head of the tripod the thumb-screw which secures the camera to it, only setting up the screw tight enough to hold the camera in place, and allowing it to be turned from side to side as may later on be required. This done, see that the camera is level, look at it from all sides; this is an all-important step, especially when an architectural object forms part of the picture.

The tripod resting firmly, the camera being level, next remove the cap from the front of the lens and place the focusing cloth over all excepting the front of the lens. With the lens there should be diaphragms. Of these there are several; they are flat, thin pieces of blackened metal, with holes of various sizes in their center; they are also known as "stops," and are frequently spoken of as "openings." In focusing, which is soon to follow, we shall use the largest opening or stop, for the reason that the image is brighter on the ground-glass, due to the letting in of more light than could be admitted through

the smaller stops. Having arranged the stop as suggested, and having removed the cap from front of the lens, next step to the rear, raise the cloth, and place it over your head.

What do you see? Nothing, unless you have used a camera before. You would scarcely have thought so; but there is quite a "knack" in finding the image on the ground-glass. You are probably too near. Raise the cloth a little and draw your head slowly back, the image will soon appear. Now close the cloth tightly, so as to exclude all the light, moving to or from the glass, until you have the proper focus for your eye. Next loosen the thumb-screw that holds the movable part of the camera, so that by slowly and steadily moving the ground-glass to or from you, you obtain a sharp image on it; this your focusing-glass will enable you to do exactly. In using, place it against the back side of the glass and your eye at the lens in the small end. It may be that the focusing-glass does not suit your eye; it is adjustable; the eye-piece can be moved in or out as may be required. Test it, however, by holding the ground-glass between your eye and the light, the ground side from you, and move the eye-piece until the glass on the ground side looks rough and distinct, as it will do under proper conditions. In the landscape before us so move your camera, by turning to right or to left on the tripod, as to bring the rustic seat into or near the upper right-hand corner of the glass, and the villa nearly to the lower left-hand corner, as you see the inverted image before you. This upside-down condition of things will confuse you at first, and so will the appearing on the right of objects which are on the left, and those of the left on the right. However, you will soon become accustomed to this new order of things. In examining the image you may find that the villa is not all upon the plate. To bring it on, raise the sliding front until it is all upon the plate, and a fair piece of sky as well. If in doing this you have not lost your rustic seat in the foreground, all is right. If you have, then you are too near your objects; move back, taking up a position that will give you on the ground-glass all the objects you wish to have upon the sensitive plate. Your sliding-front will bring in more foreground by lowering, more sky

by raising. Be sure to fasten it tightly when the proper position has been found; and fasten also the camera to the tripod by setting up the screw beneath. Nothing has been said as to letting down and making fast the folding bed. This, it is assumed, has been done.

In this picture you will find no use for the swing-back; indeed, it is not often required for field work; when you are so placed as to have an object immediately in the foreground, so near that you are unable to obtain sharpness, you may use the swing-back to advantage. In this case, set back the top which lengthens the foreground focus, so that the whole may be equalized. When not in use, be careful to have it firmly fixed at right angles to the bed or platform.

Now focus the image which has been arranged upon the glass. Choose some object in the middle foreground, the bark of a tree, a cluster of rocks that are moss-covered, any object, in short, on which, by aid of your glass, you can sharply focus. This done, examine the rustic seat in the near foreground, and the villa in the right distance; both are beyond doubt lacking in sharpness; now is the time to see what the stops will do. See if by using the next smallest stop sharpness is obtained; if not, the next, until all parts of the image are sharp; this, within fairly reasonable bounds, providing the lens is suited to the size of plate in use, can be had; but, as you have seen, at a great sacrifice of light; which, however, we cannot avoid. In using the stops or diaphragms, always use the one with the largest opening that will give you the desired definition or sharpness; this for two reasons: you get more light on the plate, thus making your picture in a shorter time; and you get a more crisp, brilliant, and pleasing result. Before the camera has been long in use, the careful student will find that the nearer an object is, the further apart will be his lens and his ground-glass when he makes sharp the image, and closer together when the object is at a greater distance. He will also have observed that when the focus has been found for an object 75 to 100 feet away, and the proper stop has been used, that all beyond that distance is equally sharp. Knowing this, a mark on the folding bed is made, and

all pictures within certain distances, can be made without using the ground-glass; the ground-glass is placed at the marked spot, and the photographer goes ahead with certainty of success. Were it not so, the beautiful pictures of moving objects could not be made; to locate them on the plate, a little instrument is placed upon the camera, termed a finder. Of this, and its uses, however, more will be said when the methods of making instantaneous pictures are described.

LESSON III.

THE DARK-ROOM.

In some part of your house a closet can be found with a tight-fitting door which will meet all your wants; the larger the better, for your ruby light and your breath will very soon destroy all the air for breathing purposes. If you can, build a room in some part of your house, and when building provide for proper ventilation; it will well repay the little cost of the few boards needed. Make it six feet wide, ten feet high, and twelve feet long. Ventilate it by having made at the tinsmith's four tubes shaped like the letter U, one end one-half the length of the other. On the long end have a flange. Cut two holes in the wall of the room at the bottom and two at the top, the size of the inside of the tube, and nail the tube by the flange to the wall so as to cover these holes; the tubes should be a foot one way by six inches the other in the clear; paint them inside and out a dark, dead color to prevent reflections of light.

This simple and inexpensive method will add to your comfort on hot days, and help to keep the air of your dark-room pure. Locate the door of the room at one end, or as near one end as possible, using the end farthest from the door for changing and developing plates. Construct around the room a wide shelf at such a height that, when sitting on a chair, your knees will pass comfortably under it; on this shelf, at the side, you can place the plate-holders when you wish to fill them; at the end you will have room for your developing operations.

Make other shelves above as you may wish them, on which to place your "traps" and store your negatives. If running water can be had in the room you will be most fortunate. It is assumed that you are not so fortunate. At the

end of the room where developing is to be done, first settle upon the spot where you are to place your ruby lantern, by the light of which all your work is now to be done. Of these there are many kinds; the cut represents one that is inexpensive and reliable. Should you want a larger one, it is easily found.* In front of this place an ordinary heavy sheet iron pan, such as is used for baking, measuring about sixteen inches by ten inches wide; this is to constitute your sink, over which developing is to be done, and it should be two or three inches deep. In the bottom of this pan have a piece of lead pipe soldered to carry the water entering it to a pail underneath the shelf. In this pan construct and adjust a wooden frame of four strips of wood, on which your developing tray can rest clear of any dirty sediment that may collect in the bottom of your little sink. Next construct a shelf on your left, and within handy reach without leaving your seat; on this set a pail, which is to hold your supply of clean water. Put in this pail a stop-cock, and over the cock slip a piece of rubber tubing long enough to reach to the developing tray over your sink when in position in front of your ruby lantern.

W. I. A. Ruby Light Portable Lantern.

Have the pail in which the clean water is kept a little smaller than the one into which the overflow passes; this precaution may prevent marring the ceiling below you.

Sitting down to your work may be thought a lazy way of doing things; it is comfortable, nevertheless. Having arranged our room for its uses, let us now see what is needed to do our work. Of chemicals we require sulphite of soda in crystals, a small quantity of sulphuric acid, pyrogallic acid, carbonate of potash, alum, hyposulphite of soda, and a bottle of varnish; also a pair of scales fine enough to weigh grains. For weighing more than an ounce the ordinary house scales, if good ones, will answer. If you buy the developer already mixed you will not require scales, nor will you need either of the first four named chemicals. To mix your own developer is

* The W. I. A. petite lantern is excellent, being an improved form of the original W. I. A.—Editor.

scarcely cheaper, but it is better for a beginner, for it acquaints him with what he is to use. After becoming perfectly familiar with the developing solutions, their constitution and use, you may save time and trouble, if not, indeed, some expense, by buying the developer ready prepared.

You will require four glass graduates, one each of eight, four, and two ounces, marked with drams, and a minim glass to measure drops.

SCOVILL GLASS GRADUATE.

Three trays or agate iron pans must be had, one for developing, one for the alum solution, one for the hyposulphite or fixing solution, each to be kept for its own use, and on no account to be ever used for anything else.

For developing use the shallow pan; the others should be the deep style, being always the size next larger than the size of plate you use. For the alum and the hyposulphite of soda it would be better to employ the second size larger.

AGATE IRON PAN.

Agate iron pans with pouring lip, the following sizes are

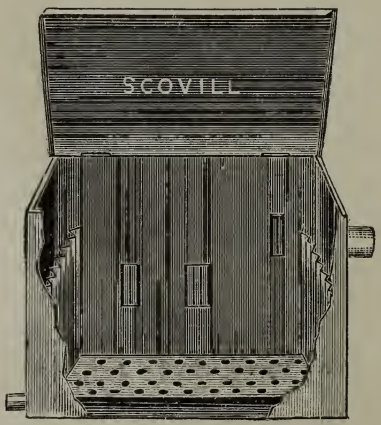
supplied, either shallow or deep: 5 by 7, 7 by 9, 8 by 10, 10 by 13, 11 by 14, 14 by 17, 15 by 19, and 19 by 24.

A couple of funnels and a glass mortar you may be able to dispense with, though to have them will add to the ease of working.

Agate Iron Corrugated Funnel.

Glass Mortar and Pestle.

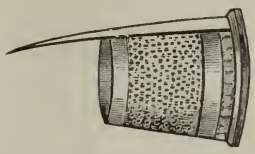
If about the house you have running water, by all means get a negative washing-box, attach a rubber tube to the opening in the lower left-hand side, as shown in the cut below, and the other end of the tube slip over the faucet of the wash basin, thus allowing a stream of water to pass into the box, around the plates as they stand on edge in the grooves and overflow at the opening on the right hand.



Scovill Negative Washing-box.

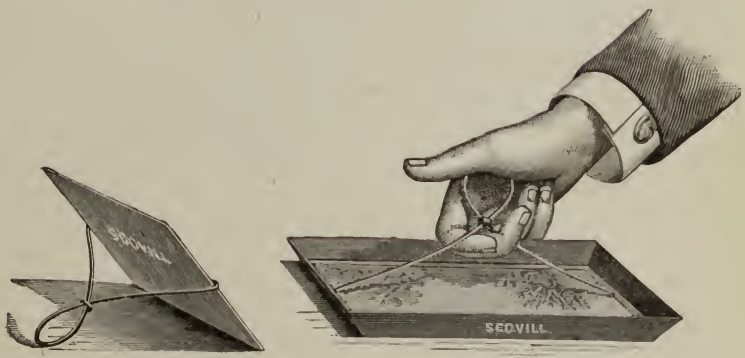
One little thing more, and we shall be ready to develop a

plate when the proper time comes. The cut below explains itself; its cost is but a few cents.



SCOVILL'S PLATE-LIFTER.

Scovill's plate-lifter for raising plates out of the developing solution without soiling the fingers.



RUSSELL NEGATIVE CLASP AND DRYING SUPPORT.

By using the Russell negative clasp and drying support, there is no need of wetting or staining the fingers in the developer, or of touching a plate until after it has been developed, varnished, and dried. They are adapted for all sizes from $3\frac{1}{4}$ by $4\frac{1}{4}$ to 8 by 10, inclusive.

Of plates many manufacturers make several brands. Some are intended for instantaneous work, others for landscape, or subjects of still life, and for transparencies such as may be hung in the window, made into lamp shades, or for use in the lantern; all are packed in the same way.

All are put up in paper boxes containing one dozen, in the following manner: On the bottom of the box a plate is laid face up—that is, the side on which the sensitive preparation is

placed; on this either a thin piece of paper is laid, or some other method is used to keep its surface from coming into contact with the one next above it, which is placed face down. The third plate is placed back to back to the second plate, and so on face to face, or back to back, to the top plate, which is back up.

Before opening the box containing the plates provide yourself with a broad, flat, and very soft brush of camel or sable hair at least two inches wide; light your ruby lantern, lay the brush on a clean piece of paper at your side, and all is ready for opening the box containing the sensitive plates. It is to be assumed that in an outer room you have opened and thoroughly dusted and cleaned the plate-holders or shields, as they are often called. This should be done quite often; if not, you will probably find on your negatives transparent spots, the result of small specks of dust from dirty holders.

If you use the kind of holder shown in cut in Lesson I., you will notice a slide at the left; this acts as a partition between the two plates; on either side is a flat spring of sheet brass, which presses against the back of each plate, holding it firmly in position. When this partition or slide is in place, it is held there by a catch on the edge of the holder. The slide on the right is the one which is drawn out when the holder is placed on the camera, and when all is ready to make the exposure. Of these there are two—one in front of each plate; the other in the cut is seen as closed.

Before we close the door of our dark-room let us loosen the catch on the slide between the two plates, and pull each one in each holder out a short distance and place them on the shelf in order at our left, closing tightly the slides that are in front of the plates. This done, we close the door and fasten it on the inside to keep out any curious friend who, on entering, would bring in a very bad friend—light. This precaution taken, we sit down comfortably in our chair facing the broad shelf, having on one side the empty plate-holders, on the other the brush, and in front the box of sensitive plates; these, to begin with, shall be Carbutt's B or landscape plates.

Take the box, open it with care, removing lid, and turning

back to each side the paper that covers the plates; then by the edge gently raise the top plate, which we find back up. This can easily be determined, if in doubt, by holding it at an angle towards the .ruby light, the back showing a bright reflection, the face a very dull one. Take the plate by one corner in the left hand, being careful not to touch its face except just at the corner, and pass the broad soft brush gently over the sensitive surface to remove any particles of dust that, in the shaking it has had in the box, may have lodged on it. This done, lay down the brush, take plate in the right hand, and, having withdrawn the partition slide from the plate-holder, put the plate just dusted carefully into one side of it, facing the outside; dust another plate and put it into holder, face out, as before, thus bringing the backs together; then slip in the partition slide between the two plates and fasten it; be sure that the other slides are also closed, and holder No. 1 with two plates is ready for use. Be careful in sliding in the plates that you do not bring the face in contact with the holder, otherwise they may be scratched; the same care must be used in taking them out. If any plates are left in the box, mark the number in it, the kind of plate, secure it by a string, and put away in the darkest corner of your dark-room for future use.

This work may appear to be most simple, and so it is; all things appear simple to those who know how to do them and are in constant practice, but to the beginner the most simple thing often seems difficult, until mastered. It will be awkward work the first time; you will not be able to work with ease in almost total darkness; you will probably drop a plate or two on the floor; some of them will be put into the holder wrong side out, or scratched putting them in, and, without doubt, you will cut your fingers with the edges of the glass. None of these blunders will be made oftener than is necessary to teach you not to do it again, however.

There is considerable knack in handling a plate so that its surface shall not be injured or one's fingers cut; to save the latter, be careful not to draw the fingers along the edges; if you do, it will probably spoil the plate and hurt your fingers.

On filling the plate-holders you are ready for exposing, which will be treated of in the succeeding chapter.

LESSON IV.

EXPOSING.

No FIXED rule can be given for this part of the photographic operation. No end of conditions serve to change the time required even in a day's work out-of-doors; in-doors it is much more simple, shortening the time as we approach midday, and lengthening as we pass into the later hours of the afternoon. From eleven until two o'clock is the time when exposure should be the shortest; an hour or two before sunset the slowest, for then we often have in the summer months a peculiar red or yellowish light which renders photographing almost impossible.

The later spring and early summer months, as a rule, give the quickest lights; the fall months, though the days may be clear to the eye, are often hazy and yellowish in their color of light. Longer exposure will sometimes give us all we desire, always providing there is no haze. This no amount of time will ever offset. When a haze or fog obscures the distance to the eye, do not make any attempt to work on distant subjects. It may be that subjects very near can be made, there being less haze or fog to look through; but this depends altogether on its density.

Under-exposure and over-exposure outside of certain comparatively narrow limits, is in a general sense fatal to the best work; yet there is what photographers call latitude of exposure, which, be it more or less than just right, is not of necessity fatal to good work. For instance, if four seconds should be exactly the right time of exposure to give on a certain subject, and either two or six seconds should have been given, the negative in the hands of a skillful photographer would not be lost; it would be noticed in the operation of development, and, as will be later shown, the method of treatment would be so changed as to produce a good negative. The main trouble in over-exposed and under-exposed plates lies in the fact that we do not discover the error

soon enough to apply the remedy. It is much easier to save a plate that has been over-exposed, however, than one which has received too little time.

When in doubt, therefore, give the doubt to the side of over-exposure. Time enough must always be given to impress the image on the plate; you can restrain an over-exposure, but no amount of coaxing will ever bring out in the negative that which has not been put there by your lens. You might as well give it up first as last. Photography will do a great deal now-a-days, but it will not make an instantaneous picture of a yellow horse against a green back-ground; it might do something for you if the horse was white. This brings up another phase of the subject, which at first may give you trouble. The photographic character of subjects varies as greatly as does the subject. The view of a house that is painted white will require less time for exposure than one that is painted with the reds, browns and yellows, so common of late. Spring foliage will require less time than summer foliage that has faded somewhat, while the glorious tints of the fall are practically, if not wholly, beyond our art. People with sallow complexions and dark dresses will require more time than the child or young person whose complexion is clear and bright, and clothing light in color. Dark eyes, as a rule, photograph well; light blue eyes do not. An ordinary open view with a Waterbury lens and medium stop will probably require, on a good clear day, about two or three seconds' exposure; with a Morrison wide-angle, half that time. If the view to be made is through a well-wooded lane or roadway, or of a house well hidden in trees, the time might be ten or twelve seconds; if of a dull lighted interior it may take hours.

From what is written it may be that the reader is fearful he will never know how much time to give. Do not despair; you will learn more easily than you imagine. A certain rule as to the time required for any given subject —the rule which the writer fancies must be the rule of all out-door workers—is this: The point of view having been selected, the camera in position, everything ready for the exposure, I stop a moment, look carefully over the view, call

to mind a certain view which in character of subject and conditions of light is similar to the one before me, and to which the right time had been given, judge this one by that, and expose accordingly; giving it the same, or more or less, as, in my judgment, it may seem to demand. In my memory there are stored away for such use a few instances, which I may be allowed to term as samples; one at least of them is quite certain to meet the present want; by it, as stated, I measure this. Of such samples there need not be many. A broad open view, with distance, a view through a road well shaded by trees on either side, a view in woods with heavy foliage, a view through a grove with medium distance and rocky foreground; such, and others, that I do not need to name. Each have to me a certain photographic value; each I know well as to time given. I choose my sample, as I have termed it, and use my judgment. To one who has no standard in his mind this may appear difficult to understand; later on, when you have made a few good negatives, you will have them impressed on your memory and can then choose your own samples. There seems to be a sort of intuition about this matter of exposure that makes the subject hard to explain, for even after you have taken the cap from the lens, your mind made up as to the time, the chances are more than ever that you will change it to a longer or shorter exposure, which nine times out of ten will be the right thing to do. This, of course, is after experience has been had.

An authority in photography said, many years ago: "In the whole range of photographic manipulations, the sum of which goes to make up the perfect picture, there is not one of more importance than the correct time of exposure in the camera." This is true to-day.

In generalities enough has been written; let us now take our camera and plates and have "a shot," as we call it. In other words, let us make our first exposure. See that the camera and lens are clean and free from dust; see that the holders are tightly closed before leaving the dark-room; see that they are in a good box to shield them from the light, not forgetting that, although light we must have, we want only that which passes through our lens; it is our friend, yet, by carelessness, it will prove our worst enemy.

The plate-holders must always be well cared for, never laid about upon the grass in the sun; keep all in the box but the one in use. Let us put up the camera here; a good foreground, moderate distance, bright foliage. Set tripod firmly, focus with a large stop in lens on an object, say a hundred or so feet away, adjust the sliding front, and turn the camera to one side or the other until you have upon the ground-glass the subject you wish. Keep the camera level, changing the stop to the size that will make foreground and distance both clear and distinct upon the glass; if immediate foreground is not as sharp as it should be, draw back the swing-back at top until it is; screw up tightly all the set screws, and cap the lens.

After these things have been done, remove the ground-glass, take plate-holder from box, throw your focusing cloth over it, close box, and put holder in place of the ground-glass; draw the slide with a steady motion until nearly out, then with a quick motion entirely out, keeping cloth over it the whole time, and letting it remain over the holder until it is returned to the box. You are now ready to expose; study object, settle in your mind the time you should give—let us say it is four seconds on a Keystone B plate—uncap, give the time, and re-cap. In taking off and putting on the cap do it quickly, but be careful not to jar or shake the camera, particularly when you uncap. If you do, you may cause vibration, and thus render the picture indistinct.

The lens being capped, raise the corner of the focusing cloth that covers the holder, and return the slide you had removed. Do this by a steady, quick motion, shielding it with the cloth and putting in the slide squarely, not one corner first, for inside there is a spring to cut off the light when the slide is withdrawn; examine it when empty and you will see why it must go in square. Be particular about this.

Having now made one exposure, which we will assume to be exactly right, let us make two more, which, we shall find, later on, are wrong; one say for two seconds or a little less, and one for six or seven seconds, giving us for a future lesson one that is right, one that is under-exposed and one that is over-exposed; their action under the developer in the next lesson will give us the proof.

Later, it will be seen that the plate to which was given four seconds proves to be just right—a good, clean, clear, sharp negative of fine intensity, all that we want. You now have a sample, as we have termed it, or standard, for that character or class of views; for such, in future, you now have something to measure another exposure of similar subject by; if of little thicker foliage or foreground, or little less brilliant light, then in your judgment a little more time; if the reverse, then a little less time.

LESSON V.

DEVELOPING.

Development is that part of the photographic art which brings to sight the latent or hidden image on the sensitive plate after it has been exposed in the camera; it is a delicate operation, requires close attention, good eyesight and judgment, oftentimes patience, always care and cleanliness. It can only be carried forward when all but the ruby light has been excluded; if successful in it, we have our greatest photographic joy; if not, our greatest disappointment; for if a success, we have a negative from which, with care in its handling, hundreds of charming prints may be made. Before proceeding to develop the plates exposed in the last lesson, let us put our house in order, make the developer, etc., so that, when we close the door of the dark-room, everything will be at hand and just where it should be. A good motto for the dark-room would be the old one of "a place for everything, and everything in its place," not only for the reason that it is always well to have it so, but that in the darkness of the dark-room it must be so, otherwise we are not able to work. So dim is the light, excepting only that which is just before us, that, if anything is wanted, we must know just where to put our hand to find it.

Always, before commencing, wash thoroughly each article that is to be used; cleanliness in photography is but the synonym for success. The developer which we shall first use will be made after Mr. Carbutt's formula; it differs but little from many others, is simple, and works satisfactorily. Just here let us impress one thing upon the student. During these lessons, use this developer only; under no circumstances try any other, for most excellent work can be made with it. Leave experiments to the future, follow instructions closely;

if you do not, confusion and failure will result. As a rule, almost without an exception, beginners make very poor work. There is no reason why they should make good work. They blame their formulæ instead of their own lack of knowledge and practice; somebody says use so-and-so, another something else; the work does not improve, discouragement follows, sometimes the charming art is given up in despair. Stick to the simple rules here given, and you are sure to make good work.

Now for the chemicals needed to compound the developer:

Sulphite of soda, crystals	1 pound.
Carbonate of potash, granulated	1 pound.
Carbonate of soda, granulated	1 pound.
Pyrogallic acid	4 ounces.
Sulphuric acid	1 ounce.
Bromide of potash	1 ounce.

This quantity of chemicals will give you enough developer for nearly three hundred plates of 6½ by 8½ size, and will, if used with care and bought of a conscientious dealer in photographic chemicals, not cost you much over one cent for each plate, reference being had to the proportions given below, and used on plates to which proper exposure has been given.

To compound the developer for use, proceed as follows: Procure two twelve-ounce bottles of clear white glass, for reason that you can always see if they are clean, with well-fitting corks; mark one "No. 1, Pyro;" the other "No. 2, Potash" This done, take the eight-ounce graduate, put into it five ounces of good, soft, spring water, or better still if in doubt as to the quality of the water, use that from melted ice. Weigh and add two ounces of sulphite of soda crystals, stir with a glass rod or stick until dissolved, then add slowly half a dram, fluid measure, of sulphuric acid; to this add 240 grains of pyrogallic acid; when dissolved fill up to eight ounces with water.

Next take the bottle which has been marked "No. 1, Pyro," place in it the funnel, into the neck of which you have first placed a little wad of clean wet cotton; pour the solution into the funnel, having the cotton loose enough to allow the solution

to trickle slowly into the bottle. This solution is good for use so long as it is clear. When it becomes opaque or muddy-looking it must be rejected.

Next make up a solution for the bottle marked "No. 2, Potash," by dissolving one ounce each of potash and soda in five ounces of water; then add water to make eight ounces; filter in same way, being sure that the filter has been thoroughly washed. In hot weather, when chemicals work more rapidly than in winter, it is well to add to "No. 1, Pyro," about fifteen grains of bromide of potassium. The contents now in the two bottles form what is known as stock solution, and for the process of developing are used as follows:

Water	4 fluid ounces.
No. 1, Pyro	2 fluid drams.
No. 2, Potash	2 fluid drams.

Of this, in the proportions as given, as much may be mixed as at one sitting is likely to be used.

The developer being ready, wash the pan or tray in which it is to be used, and place over it the large pan described in a previous lesson, in front of the lighted ruby lantern. Place the holders containing the exposed plates, and the developer in handy position within reach, close and fasten the dark-room door, and take your seat facing the lantern and tray.

All being ready, remove the slide which divides the plates in holder, and let the plate to which four seconds' exposure was given, slide out slowly face up to prevent scratching the film on face of plate, close holder, and lay the plate in the tray face up (the dull-looking side), then with a sweeping motion from one side to the other, pour the developer over it; do not pour upon one spot, but gently sweep it over the whole face.

This done, move the tray from side to side, being careful to have the solution wash over all parts of the plate and keep it gently in motion. Should an air bubble appear on any part of the plate, gently touch it with a finger and break it, otherwise you will have a spot, on which the developer not acting, after the process of fixing, will be transparent. In a few moments

a shadowy or darkening appearance on part of the plate will be noticed gradually growing in distinctness; this will be the high lights, the sky, or objects of a light color on which the strongest light has fallen, followed by an indistinct outline, as it lies in the tray, of the view or picture thrown upon the plate by the lens. In a moment or two it will slightly fade from view, becoming less distinct; then with the thimble on your forefinger slip the point of the little spear on thimble under the plate and raise it from the tray; hold it up to the light, and examine as to its intensity and the detail of foliage, and see if the objects which were in shadow have all appeared.

If not quite intense enough, in other words, not so opaque in the sky as to shut out all light as viewed by the ruby flame; if the details in the shadows have not appeared, the bark on the trees is not distinct, replace it in the solution and continue the operation until these conditions are attained. Then wash it with a gentle stream of water from the upper pail, and it is ready to place in the alum solution. This we shall not do in this lesson, but will stop with the development.

Next, let us take the plate to which we gave two seconds or a little less, treat this in exactly the same way, and we shall find that it "comes up," as photographers say, very slowly. We wait patiently, but the details do not appear in the shadows, the high lights become very opaque and intense; there is much more of the plate on which nothing appears than there was in the other; we continue twice as long in our efforts to "get something out;" it does not come; we give it up and wash as we did the other.

Lastly, we take the other and last plate, to which we gave an exposure of seven or eight seconds; treat this as the others; almost instantly we notice the action of the developer; it works rapidly; the whole view seems to flash up at once, detail in shadows, everything "comes up," almost instantly; it appears to finish at once; we take it from the tray, and to stop further action of developer wash it. Here we will let them rest for future treatment, although the operation is, in practice, a continuous one. For each plate a fresh solution must be used. Between the development of each plate wash the tray by play-

ing the little hose into it to remove any of the old solution that has become a dark-reddish color.

If in developing a plate that has had the right exposure given it, you should stop short in the development, you will find the details in the poorly-lighted parts of the plate are wanting, and the intensity of the high lights and sky not dense enough to shut off the light when you come to print it on paper. This intensity should be such as to give, when the print is made, just a faint tinge to the paper, not so dense as to stop all light and leave the paper a pure white, nor lacking in intensity to such a degree as to allow the passage of too much light so as to make a dark, dull, heavy sort of sky. If we push the development in the under-exposed plate in our efforts to get out the details, we shall have the sky very dense, and, lacking the details. We have, when finished, a large portion of the plate that is little more than clear glass, giving us a negative of severe contrasts, and worthless, yielding a print with an absolutely white sky and heavy dark shadows.

The over-exposed plate will, if we push the development, or continue it too long, grow up, as it were, all over the plate, and, when finished, be of too even a tone, too much alike all over, lacking in contrast; if stopped short it will be lacking in intensity in the high lights, and, like the under-exposed plate, worthless.

Over-exposure, if not too great, we can control. If you have reason to know that a plate has been over-exposed, make the developer as before, with this change: use but half as much of the No. 2 solution, and add half a dozen drops of a solution of the bromide, made up 50 grains to the ounce of water. The cutting down of the No. 2 will make the development slower; the bromide will also restrain the rapid action, and help to gain intensity. If it still dashes up, pour off solution, and add a little more bromide; if too slow, add a little more of No. 2. In this way, you may be able, by judgment in variously compounding, to save a day's work that has been over-exposed. No amount of writing can tell you more than this; practice alone will teach you. If a plate is but little under-exposed, it may

be saved by using more of the No. 2; if much so, do not bother with it, for an image not impressed on the plate cannot be developed.

If at any time a fog seems to overspread the plate, a sort of a veil, as it were, thrown over it, it may be from one of many causes, among them over-exposure, improper shade of ruby glass, light entering the dark-room, a camera or holders that are defective, an old and decomposed solution of No. 1. Fine transparent lines on the plate may come from using a brush to dust off which had bristles that were too stiff; or from injury to plate in putting in or taking out of the holder.

Spots may occur from not breaking air bubbles, or from dust on the plate. A transparent patch along the edge of plate is often the result of not covering it with developer; the same careless act will give you a portion of the plate which varies in intensity and detail from the other parts. A swelling up, or "frilling," as it is termed, generally along the edges, is the result of using a developer at too high a temperature.

As yet the negative cannot be exposed to white light; it must pass through the alum and hyposulphite of soda before it leaves the dark-room; and in the next lesson we shall learn how to perform these operations correctly.

LESSON VI.

FIXING, WASHING, VARNISHING, INTENSIFYING, AND REDUCING.

PROCURE two half-gallon glass jars with wide mouths. In one make up the alum solution, one part of alum to eight or ten parts of water; in the other, the "hypo" solution, one part of the hyposulphite of soda to five parts of water. When dissolved, these solutions are ready for use; they need not be filtered.

These chemicals you can buy by the pound; they are cheap and come neatly packed in paper boxes. For this work, purchase two trays of size eight by ten inches and about two inches deep (see Lesson III.), one to be used for each solution, of which pour enough in the tray to fully cover the plate; if a dozen plates are to be passed through, put in a larger quantity than for a few plates; when through, throw it away. The "hypo" especially should be renewed when it works slowly; it should do its work, as will be explained later, inside of ten minutes.

The negative having been washed after development, as directed in last lesson, is placed in the alum solution, in which it must be allowed to remain for four or five minutes; wash again, and then place in the "hypo" solution, where it must rest until all of the whiteness has disappeared, as seen from the back. This may be conducted in the dark-room with the door open, in a weak light; it is not well to trust to a strong outside light, however, until all the whiteness has been removed by the "hypo;" after this you may expose it to any light.

This is known as the process of "fixing." If, after taking the negative from the "hypo" and examining it by a strong light outside the dark-room, you should notice any brownish-mottled appearance in looking through it, return it to the "hypo" until it is removed. The operations herein described

do not need any great skill or judgment; they are not as difficult to conduct as the exposure or the development; yet, simple as they are, they need care and attention, especially the "fixing."

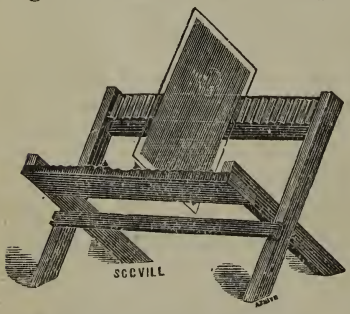
Let us again impress on the attention of the student the necessity of conducting this part of the process in a very weak light; do not open your dark-room door until the plate has been placed in the "hypo"; even then it is better to cover the tray while the door is opened. After it has been in the "hypo" for five minutes the cover may be removed and the plate examined by looking at the back, when in most cases you will notice a whitish cloud on a portion of the plate not yet dissolved by the action of the "hypo;" permit it, as before stated, to remain until this has disappeared.

Thorough "fixing" is all-important; on it depends the life of the negative; if but half done, you will some day (it may be a week or months) discover a brownish stain on that part of the plate on which the "hypo" had not fully acted.

Washing.

After the "fixing," the plates are placed in water to wash; running water, if you have it; if not, in a large tub or pail in which the water should be changed two or three times an hour for several hours; if running water is used, an hour will be ample time for the washing.

In Lesson III. an illustration of the Scovill Negative Washing Box is seen, a cheap and effective apparatus for the purpose. Upon removing the plate from the water, place in a drying rack, or in some way on end, and allow it to dry spontaneously.



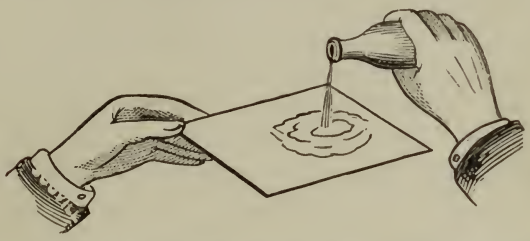
Scovill's Negative Drying Rack, made with either Wooden or Corrugated Zinc Rack.

If in haste, place it in the sun or near the stove, and you will learn that it will not dry; it will melt the gelatine in the film, and teach you the lesson that will prevent its repetition.

Next in order is

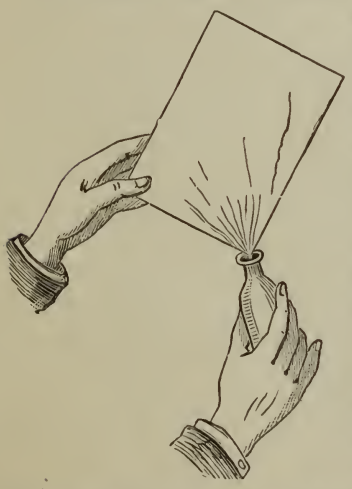
Varnishing.

The negative must be absolutely free from all moisture. This will probably be the case on the day following development. If in doubt hold the plates near the fire to drive out all moisture for a few moments, or stand them in the sun for a while, an operation that may be performed, since the water no longer saturates the film. For amateurs' purposes it is rarely necessary to varnish. With care, scores of prints may be made from the unvarnished negative without damaging it in the slightest, but for those who may wish to varnish it is well to describe the

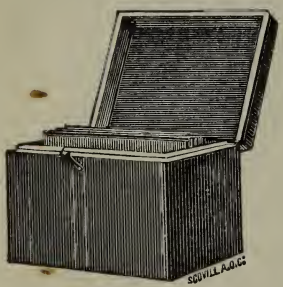


process. Varnish can be had especially for this purpose already prepared; it is known as Scovill's Negative Varnish.

The plate being dry, seize it by the lower left-hand corner, as shown in the cut, holding it level and pouring from the bottle on to the film quite a pool of the varnish. Then slowly lower the end farthest from you, allowing the varnish to spread to the further end; then depress the upper edge, flowing the varnish slowly along to the spot where your thumb is, then to the corner next to you, gradually rising until you reach the position shown in the cut, when the surplus is drained back into the bottle. While draining keep up a rocking motion to and from you to break up any tendency of the varnish to set in



ridges; cork bottle and put plate in drying-rack until the varnish hardens. This will take at least two or three hours.



When a number of negatives have been developed and varnished, there are two methods of preserving them from dust and from scratches. One is by putting them in envelopes made of stout paper, and called "negative preservers," which are sold to correspond with the different sized negatives. Another way is to store the negatives in boxes like the one shown. These are called "negative boxes," and are constructed to hold twenty-four negatives, which are slipped into the grooves at the two sides, and thus secured from rubbing each other. These boxes are also made light-tight for holding unexposed and undeveloped plates. Some, too, are provided with lock and key, which often is a convenient addition.

The negative is now ready for printing, but before we proceed to describe that process let us consider some of the methods for improving the quality of the negative by increasing or reducing its density.

Increasing and Reducing Intensity.

It sometimes happens that a negative lacks intensity, from causes which are not at this time worth reciting. If you have a negative of a view which you cannot easily retake, and which has all the needed details in the shadows, then it may be well to try some strengthening or intensifying process, but if you can duplicate it, by all means do that. If it has not the requisite detail, throw it away, for all the intensifying that can be done will but increase opacity; detail you cannot add; if the image is not upon the plate a ton of chemicals will not put it there. At its best, the operation is far from being satisfactory, as a rule; an intensified negative is never as fine as one correctly exposed and *properly developed*. The formula recommended by Edwards has acted as well as any. Prepare a saturated solution of bichloride of mercury in water, and pour

of this a sufficient quantity into a solution of iodide of potassium (one and a quarter ounce of iodide to six ounces of water), until the point is reached when the red precipitate is not dissolved by shaking; be careful not to add more mercury than is just enough to leave a slight precipitate.

To this add one ounce of hyposulphite of soda in crystals, and add water to make twenty ounces.

For use, take in proportion of one ounce of above to three ounces of water, and in this place the plate to be intensified. Should the plate not have been well washed after the "fixing" process, yellow stains will appear from the traces of hypo left in the film. Be careful not to carry the operation too far; wash well. Hall's intensifier, which is sold already prepared, is used by many because of its convenience. Merely flow it on the plate until the proper density of color is obtained; then wash in pure water and dry.

If in the development you have gone too far and the negtive is too intense, it can be reduced by the following:

Red prussiate potash	1 ounce
Water	16 ounces
Hyposulphite of soda	1 ounce
Water	16 ounces

Pour out enough of the hypo solution to cover the plate; to this add, say, four drops of potash solution to each ounce of the hypo solution. Mix well, and in this immerse the negative; watch closely, removing the plate from time to time, that you may see how the reduction proceeds. When reduced sufficiently, wash well and dry.

It is better in developing to err on the side of too great intensity and then reduce, than to stop short in development and endeavor to intensify. The first may prove a success; the last, as a rule, is scarcely satisfactory.

LESSON VII.

PRINTING ON ALBUMENIZED PAPER.

The Silver Solution.

The albumen paper that is sold by dealers has been soaked in an alkaline salt, and when such paper is floated upon a solution of silver nitrate, two compounds are formed; the organic albuminate of silver, and silver chloride, both of which are sensitive to light.

A sixty-grain solution of silver nitrate may be recommended, that is, one which contains sixty grains of silver to the ounce, although a much weaker one will answer the purpose tolerably well. As a matter of course, the bath grows weaker with use.

Such a bath may be made as follows:

Water	64 ounces
Silver nitrate	8
Ammonia nitrate	2
Magnesic nitrate	1 ounce

To each ounce of the solution add one drop of strong ammonia.

By adding silver nitrate, from time to time, the solution may be kept up to the required standard. This may be ascertained by the argentometer; the figures at the surface of the bath in which the instrument is floated indicating the number of grains per ounce. The ordinary hydrometer will serve well enough, since we may add silver, from time to time, in sufficient quantity to keep the instrument at the same level when floated in the bath. We may, indeed, employ any glass tube closed at one end and open at the other. Cause the tube to stand upright in the liquid by dropping shot into the open end. The surface of the bath may be marked by a ring of

thread, and this mark may afterward be made permanent by a three-cornered file. Of course the tube must always contain shot of the same number and size.

On account of the presence of ammonic and magnesic salts, the argentometer should read, not sixty, but eighty. Only silver nitrate needs be added from time to time, as the solution is not depleted of the alkaline salts, except as the quantity of the liquid is diminished. The best way is to add a quantity of solution compounded as above, and then add silver nitrate to bring the whole up to the required reading on the hydrometer.

The silver-bath should be kept in an alkaline condition by adding, occasionally, a few drops of ammonia. The tendency to become acid is due to the liberation of nitric acid from the silver nitrate.

During the floating of the paper some organic particles pass from the paper into the bath, where they soon decompose and discolor the solution. The bath may be cleared by shaking it up with a handful of china clay or kaolin, which adheres to the particles and carries them to the bottom. The bath should then be filtered, or, when used, it may be decanted, leaving the sediment behind. Better yet, the bath may be drawn from the bottle by two tubes, carried in one cork after the manner of the wash bottle which is so much used in laboratories. One tube is a syphon that reaches to the bottom of the bottle, while the longer arm is outside the bottle and carries the solution into the tray. The other tube passes merely through the cork, and through this a current of air is blown; the pressure from this starts the syphon.

Floating the Paper.

This must be done in a glass, porcelain or wooden tray. If wood is used, the bottom and sides should be well shellacked. A convenient tray for amateurs is the "Waterbury" tray, of a size large enough to float a whole sheet at a time.

Lift the sheet to be floated by two opposite corners, with the film side down, and let it touch the bath first near one end.

Lower the rest of the sheet smoothly and quickly until it all rests upon the bath. Across each end lay a light piece of wood, until the curling of the edges has ceased. These edges may easily be kept down also by breathing upon them. As soon as possible, each corner of the sheet should be lifted and bubbles of air adhering to the film should be broken with a glass rod, or blown away by a smart current of breath. No drops of the solution should be spattered upon the top of the sheet. The albumen paper commonly sold in the market should be floated about two minutes in winter, and a minute and a quarter or a minute and a half in summer. For printing with weak negatives, the floating should be somewhat longer.

Withdraw the sheet by grasping two corners with wooden clips and hold it over the bath to drain. It is an excellent plan to draw the sheet over a glass rod fixed across one end of the tray. This scoops all superficially hanging silver back into the bath. The sheets may now be pressed between pieces of blotting paper and hung up to dry, being supported by the clips to stretched twine or across wooden rods. The drying should, of course, take place in the darkness, or in extremely weak light.

The albumenized side of the paper, either before or after sensitizing, should not be handled more than is absolutely necessary in cutting it to the proper size. The hands should be clean and dry. The sensitized paper soon becomes discolored and is seldom in its best condition after twenty-four hours. In cold, dry weather, however, it will keep well for several days.

Fuming.

The sensitized paper, after being thoroughly dried, by artificial heat or otherwise, should, before printing, be exposed for a time to the fumes of ammonia. The ammonia is useful in absorbing the free chlorine that is evolved during the exposure of the paper to the sunlight. To this end, secure an old box that is two or three feet long and half as wide and deep. Paste black or brown paper over the cracks, and set the box on end. The front should be removable, and might conven-

iently work with a hinge. It should fit pretty accurately, and around the margins it would be well to tack a strip of cloth. Instead of this wooden front, a large piece of pasteboard or blotting paper might be used, it being crowded in at the edges and the whole box then covered with a cloth.

Provide the box with a false bottom placed about two inches above the real one. This may consist of a porous cloth stretched across, or of a perforated thin board or pasteboard. The perforations should be numerous.

The paper is placed in the box by putting two sheets back to back and hanging them, by means of clips provided with hooks, to twine stretched back and forth across the top of the box; or, the sheets, back to back, may be pinned through the corners to the sides and top of the box. A large number of sheets may be fumed at one time. When all are in place, put a shallow tray or plate containing strong ammonia under the perforated bottom and close the front. The paper should fume about fifteen minutes in warm weather, and nearly double the time in cold weather. After fuming, a short time should elapse before printing, to allow the paper that is moist with the fumes of ammonia to contract and resume its normal size.

Printing.

The word "printing," as used in Photography, is a misnomer. The word, as seen in its etymology, means, properly, to take an impression by some mechanical means. But photographic "printing" is a process of reproduction by a chemical change that is effected in a sensitized surface through the agency of light; and might therefore be more properly styled "copying," after the manner of the Germans. The only mechanical changes involved are such as serve to bring the sensitive surface into proper relation to the actinic power of the light.

A frame that is at least one size larger than the negatives to be printed from is a great convenience. In the first place, in the larger frame the negative will be printed to the very margins; and, in the second place, the larger frame will be a

great help if you desire to vignette upon your print clouds from another negative. A clear glass plate of the same size as the frame may be used to support the smaller negative.

Place the negative in the frame, film up, and upon it lay the paper with the sensitive surface down, that is, next to the negative. Put the back of the frame in its place and press it down with the springs. The frame is now ready to be exposed to the light.

The change effected by the light in the sensitive film may be expressed by the formula:

$$Ag\,Cl + \text{sunlight} = Ag + Cl.$$

We see that free chlorine is evolved and metallic silver deposited. It is this fine deposit of silver that constitutes, by its greater or lesser amount, the lights and shadows of the picture.

If the negative is very weak and flat, that is, lacking in contrast, it were better not to print by direct sunlight; otherwise, the exposure may be made to the direct rays of the sun. To effect this, a wide board may be thrust out of a window having a southern exposure. It is better yet, however, to nail together three boards in the form of a right-angle triangle, and so place the triangle in the open window that the hypothenuse is perpendicular to the line of the sun's rays. Strips may be nailed across the board for supporting the printing frame.

The progress of the printing must be carefully watched. Withdraw the frame from time to time into the diffused light of the room, slip the spring, raise one end of the back, and examine the print. The print when ready to be taken out should be considerably darker than the finished picture is to be. This excess of blackness will disappear in the subsequent washing and fixing. Rather weak and flat negatives should be printed especially dark, as they lose more of their depth in subsequent operations. Experience alone will determine just how long to continue the exposure in order to secure the best results.

Washing the Prints.

The washing may be performed in a japanned or porcelain tray. Lay the prints one by one face down into the tray and

press them beneath the water. Twenty-five or thirty may be washed at a time. After being placed in the tray they should be moved by slipping them from the bottom and placing them upon the top. After standing eight or ten minutes the water may be poured off and a fresh supply added. The same manipulation should be performed with each washing as with the first. Into the fourth wash a quarter of an ounce of saturated solution of sodic bicarbonate and half an ounce of saturated solution of common salt may be placed. The soda will bring the prints into an alkaline condition that is favorable to the action of the toning-bath. The prints should remain in this mixture not more than five minutes, and should then be well rinsed. They are then ready for the

Toning-Bath.

The office of the gold toning-bath is to substitute for the reddish, disagreeable color of the print a bluish or brownish black. The chemical change involved is not at present very well understood.

It is a prime requisite of any toning-bath that it be slightly, but decidedly, alkaline. It should be tested from time to time with litmus paper, especially if it does not act properly.

Many toning-baths are in use and they differ somewhat in results. We will describe but one or two.

Stock Solution.

Water	15 ounces
Chloride of gold and sodium	15 grains

To make up a toning-bath for twenty prints, take

Water	10 ounces
Sodic bicarbonate	3 grains
Sodic chloride (common salt)	6 "
Stock solution of gold	3 ounces

A good pinch of sodic bicarbonate and of sodic chloride will be sufficiently accurate. To this bath add three ounces of the stock solution of gold that has first received three drops of a saturated solution of bicarbonate of soda. This last is to maintain the alkalinity of the bath.

Another excellent toning-bath is as follows:

STOCK SOLUTION.

Water..... 15 ounces
Chloride of gold and sodium..... 15 grains

Pour three ounces of the stock solution into the toning-tray and render it slightly alkaline by carefully adding a saturated solution of sodic bicarbonate. Then add a pint of water and about twenty grains of sodic acetate. After standing half an hour this bath will be ready for use.

Lay the prints in the bath one by one, face down, and move them continually, so as to avoid sticking together of the prints, and consequent unevenness of tone. Ten or twelve may be toned at one time, and as these are taken out others may be added. If the bath becomes very weak and slow in its action, provided excessive cold be not the cause, more gold should be added.

In ten or fifteen minutes the reddish color should begin to disappear and to be gradually succeeded by a rich purplish black in the shadows. The prints should not be withdrawn from the bath until this stage has been reached. On the other hand, they should never lie so long as to acquire a bluish or slaty color.

As heat accelerates chemical action, it is important that the bath be kept at about the same temperature as the room, sixty-five or seventy degrees. To effect this the toning-tray may be set on a hot soapstone; or, better yet, as some one has suggested, the tray may be set across a small open cask, in the bottom of which stands a burning lamp; but the bath must not be overheated. The prints must be examined in light strong enough to enable the operator to judge accurately of the tone. After thorough rinsing the prints are ready for the

FIXING-BATH.

The office of the fixing-bath is to dissolve the silver chloride not acted upon by light; without which the picture is subject to further light-action, will consequently not retain its brilliancy and definition, and will, in fact, assume a dark color all over.

One of the products of the fixing process is a double salt, the argento-sodic hyposulphite, which is again soluble in an excess of sodium hyposulphite, and must be totally removed from the print by subsequent washing, to secure its perfect permanency.

The following bath is recommended:

Water	1 gallon
Sodic hyposulphite	1 pound
Sodic bicarbonate	1 tablespoonful
Common salt	1 "

The prints should be placed in the bath one by one, enough of the liquid being used to cover them well. Move them frequently, as in toning, to prevent sticking together. They should lie in the bath not less than fifteen minutes. It is better to prolong the time to twenty minutes, if the bath is rather cool. The bath should be made up some hours or days beforehand, as the dissolving of the crystals lowers the temperature materially. The fixing-bath should be thrown away after once using. The fixing-tray should, under no circumstances, be used for any other purpose.

To insure against blistering, it is well to transfer the prints from the fixing-bath into a strong solution of common salt, in which they may lie three of four minutes.

They are then ready for their final

Washing.

A limited number may be washed well enough in a tray. Rock the tray occasionally, or move the prints by continually slipping out the bottom one, and placing it upon the top. The water should be changed seven or eight times, and during the earlier part of the process the changes should be more frequent than during the latter part. A thorough elimination of the fixing solution is essential to the permanence of the photograph. There is little danger, therefore, of continuing the washing too long. Some even allow water to run over the prints all night. It is supposed by many, however, that an excessively prolonged soaking in water weakens the print.

The object of washing the print is to remove from it all sodic hyposulphite and the derivatives of the fixing process. A test for perfect elimination is the iodide of starch paper of dark purple color, which, when brought into contact with prints, or the water dripping from them, will bleach immediately if only a trace of hyposulphite be present.

To remove these last traces of the obnoxious salt, a tablespoonful of Flandreau's S. P. C. Hypo Eliminator, added to one quart of the last washing water, and allowing the prints to remain therein for a few moments, and then rinsing them off again with pure water, will effect a thorough elimination, without which albumenized paper prints will always be liable to turn yellow or to fade.

The eliminator should not be used in large proportions, as by too strong solutions the whole silver deposit might suffer.

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LESSON VIII.

PRINTING ON VARIOUS OTHER PAPERS.

Printing on Ready-Sensitized Silvered Paper.

We have learned in the previous lesson how to sensitize albumen paper, how to print upon it, and how to tone and fix prints which have been made upon it.

For the convenience of professional photographers, as well as for amateurs, a brand of paper, albumenized and sensitized in the solution of nitrate of silver, quite ready for printing, is now in the market, and extensively used. This paper, being capable of giving universally good results, exempts the operator from annoyances often encountered when silvering paper, it is of especial value to the student, and some of our attention should, therefore, be given to the mode of working with it.

We have learned how to sensitize albumenized paper, and how to fume it in the vapors of ammonia preparatory to printing. With the paper before us, the first operation is dispensed with; the second, however, becomes an absolute necessity.

Before we advance further, it will be interesting to examine the reasons for which the photo-chemist has been induced to prepare ready-sensitized paper, and how it is done. Sensitive paper does not keep in good working condition for any length of time, in fact, through the influence of such adverse circumstances as heat, moisture in the atmosphere, or air tainted with certain gases, it will lose its brilliant whiteness, assume a yellowish tint, and will finally turn to a brown color, and thus become unfit for photographic printing. The theories upon which these changes are based, as well as those explaining the other processes connected with printing, we shall consider in a future lesson; be it sufficient now to say that the desire to ob-

tain a more durable sensitive paper has resulted in the ready-sensitized paper before us.

When floating a sheet of salted and albumenized paper upon silver solution, the chloride in the albumen film converts the silver nitrate to a chloride, the decomposition of which substance, by light, gives us the photographic picture. In removing the sheet from the silver-bath, much of the solution adheres to the paper, dries there, and assists afterwards considerably in making the print. This same silver prevents the paper from being durable or retaining its whiteness, and must be removed unless the paper be used the same day. This is done by washing it in water after the chlorification has been thoroughly effected. In that state we have upon the sheet a film of the organic silver albuminate, finely interspersed with silver chloride. To prevent a decomposition of these bodies by atmospheric influences or high temperature, the back of the paper is coated with other chemicals, like citric acid, citrates, nitrites, sulphites, and carbonated alkalis; the latter being probably the most effective of all. Without this precaution the washing away of the excess of nitrate of silver would be of no benefit to the paper, and it would be likely to turn color in time.

The ready-sensitized paper of commerce, as we purchase it from the dealer, may possibly give, under a very strong and dense negative, a tolerably good print, but to secure good impressions from comparatively feeble negatives, it is absolutely necessary to fume it in the vapors of ammonia. The effects produced by fuming cannot be the same as upon unwashed paper, as, without the presence of free nitrate of silver, the respective combination cannot form, and the ammonia will act only as an absorber of the chlorine gas, which, during printing, is liberated from the chloride of silver by the action of light.

The great amount of acid matter employed to make the paper durable, requires the aid of alkalis to establish that state of neutrality requisite in printing upon albumenized paper. Hence we understand how fuming assists to gain the desired result, and the importance of fuming ready-sensitized paper

cannot be too forcibly impressed upon the mind of the student.

If printed copies are well preserved from humid air, toning may be deferred to a convenient time, or until a sufficient number of prints has accumulated.

Toning, Fixing, and Washing

does not differ from the processes as described before, but it will be interesting to all to learn of the toning-bath, which has been worked with such good success by the practicing classes of the Chautauqua School, and by which equally good tones have been obtained upon ready-sensitized and freshly-prepared albumen paper.

The washing of the prints before toning should be conducted with all possible care and attention. It may be done either by subjecting them, for at least fifteen minutes, to a continuous stream of water, or to half-a-dozen changes of water at intervals of ten minutes. If, toward the end of the washing, a slight amount of alkali, say ordinary washing soda, be added, the prints will be better disposed to receive the gold of the toning-bath.

As a rule, ready-sensitized paper requires but a very slight over-printing. Long continued toning, possibly with a view to bleach out prints when too dark, is detrimental to the general tone; it turns the whites to a sickly gray, depriving the print of its brilliancy.

After sufficient washing, toning may be commenced. The gold bath, to which experts have given the name "Chautauqua Toning-Bath," is prepared about thirty minutes before use, and is as follows:

Make a stock solution of fifteen grains of chloride of gold and sodium in fifteen ounces of water, of which two ounces are poured into the toning-tray—best of a light material, porcelain or white agate ware.

Chloride of gold reacts acid, but as it does not tone in that condition, it must be rendered neutral, or slightly alkaline. Test with blue litmus paper; acidity changes the color to red, alkalines restore the blue. Neutralize the acid gold solution by

adding gradually, in small portions, a saturated solution of bicarbonate of soda, till the bluing of the litmus test paper indicates neutrality. When in that state, ten grains of acetate of soda are added, and when dissolved the solution must be diluted with not less than eighteen ounces of water, before prints can be subjected to its action.

Fixing, washing, and hypo-elimination are the same as with prints made on freshly-prepared paper.

Printing on Plain Paper.

The term "plain paper" signifies photographic positive paper, as it comes direct from the paper mills, without having undergone any preparation for future use, such as salting, albumenizing, or extra sizing.

If photographs on paper are to be finely finished in aquarell, sepia, India ink, or similar pigments, albumenized, or otherwise prepared surfaces present to the artist a variety of difficulties, among which stands foremost its gloss and hardness, repelling the aqueous mixture of color substances to such an extent as to make it extremely difficult, even impossible, in some cases, to wash in large surfaces, to blend colors into each other, or to build up intensity by repeated application of shades. Non-albumenized paper is also more pleasing to the artist, to whom the photograph serves as a sketch, or base, to work upon, and is much used by landscape, still-life, and portrait artists.

Plain paper is absolutely necessary when photographic half-tones are to be reduced into a system of lines, stipple or cross hatchings for reproductions in high relief for mechanical printing methods, for a variety of transfers, and the photographic tracing processes, which will be considered further on.

Plain paper is, of course, subjected to somewhat different treatment from that of our old friend, the albumenized paper, and of the great variety of methods practiced we select two which have been generally approved of by professional photographers.

No. 1. *A.*—Make a solution of 300 grains of chloride of am-

monium in one gallon of water, and soak the paper in it for a minute or two, being careful to avoid air bubbles. Then hang up and dry.

B.—Dissolve one and a-half ounces of crystallized nitrate of silver in fifteen ounces of soft or distilled water. Divide the solution into three parts; set one of them aside, and add to the two-thirds remaining, aqua ammonia fortior till the yellowish brown precipitate formed is redissolved in an excess of the precipitant, being careful to add only enough ammonia to render the solution perfectly clear again, and without exhibiting more than only a perceptible odor. To this ammonio-nitrate of silver solution add the third of the original solution set aside, which will cause a strong turbition of the liquid, but which will vanish by the addition of a few drops of glacial acetic acid. Then filter.

The salted paper may be floated upon this solution for two or three minutes, or what is preferred by most practitioners, the solution may be spread over the paper, fastened with pins upon a clean board, either with a tuft of clean cotton wool, or a Buckle's brush. After the paper has been thoroughly sensitized and dried in the dark-room, it may be cut to the required size and printed upon in the usual way.

Plain paper had best be toned and fixed in one operation, to secure vigorous and brilliant prints.

Dissolve fifteen grains of pure terchloride of gold in seven and a-half ounces of distilled water, and add it drop by drop, and by constant stirring up to a solution of two ounces of hyposulphite of soda in twelve ounces of distilled water. If properly prepared this solution remains perfectly clear and limpid; if brown or yellow, it is unfit for use.

Of this gold stock solution add three ounces to fifteen ounces of a ten per-cent. hypo solution, and mix well. Prints without a previous washing are immersed therein. It fixes and tones simultaneously, although it requires a much longer time to obtain neutral or black tones. Plain paper prints have shown with this method a great durability.

No. 2.—A printing method upon plain paper was given by Mr. Hardwich as early as 1856, but has for its extremely

fine qualities been retained to the present day. Based upon the presence of citrate of silver in the sensitizer, any variety of warmer tones, almost to a positive red, can be obtained with it, and it is therefore especially commendable for the use of the artist. Take of

Pure citric acid	100 grains
Chloride of ammonium	100 grains
Gelatine, previously swelled in cold water	10 grains
Water	10 ounces

The gelatine is used to retain the layer of sensitive salt at the surface of the paper, but it does not affect the tint.

Dissolve the citric acid in a small portion of water, and neutralize with carbonate of soda; the quantity (of common washing soda) required for 100 grains of citric acid is 228 grains; add the alkali cautiously, with continual stirring, until the last portions produce no further effervescence, and the immersed litmus paper, previously reddened by the acid, begins to change to blue.

The best paper for this method is the "Papier Saxe," one side of which is to be floated for two minutes upon this salting-bath. Owing to the gelatine, it is preferable to heat it slightly.

Render sensitive upon a neutral solution of nitrate of silver, 50 grains to the ounce of water, allowing three minutes contact. The sensibility to light is somewhat less than that of albumenized, but greater than plain paper, sensitized with ammonio-nitrate of silver.

When the proof is removed from the printing-frame it is of a brown or purple tint, which becomes bright red when immersed in a plain solution of hyposulphite of soda. Red prints of this sort are very popular for certain engraving or photo-engraving purposes, but to make them adaptable for subsequent operations, they must be kept from the influence of the gold bath.

Toning and fixing in one operation, may be done with the previously described gold and hypo bath, but prints should be first washed in water, to which a trace of common salt has been added, in order to remove all free nitrate of silver from

them. Aqua ammonia, if substituted for the salt in the washing, prevents changing of tones when being dried. Any variety of tones, from rich violet purple to positive black, are easily obtained, and the pictures are especially distinguished by their brilliant whites.

The Chautauqua Toning-Bath may also be employed for toning these plain prints. Gold acts upon them with great rapidity, and it is, therefore, advisable to use the normal bath, in a diluted state. As weak gold gives invariably the best results, the dilution might be with plain paper in the proportion of 1 : 3.

Fixing plain paper, when toned in the alkaline bath, requires no further admonition; no other precautions than those with albumenized paper being required. Washing and hypo elimination are also the same; but it will be observed that hyposulphite of soda is much easier and sooner removed from plain paper prints than from albumenized paper.

Cyanotypes or "Blue" Prints.

We have seen how to make photographic prints upon silvered paper, and we have received, with those methods, tones of various colors, from a warm brown to a positive black. There is another kind of print made, not with the aid of the salts of silver, but with a certain iron-combination, known by the name of red prussiate of potash, whose tones are of a beautiful and intense blue. They have gained immense popularity on account of the ease and the simplicity of the making.

The labor required to make silver photographs, even when printed upon ready-sensitized paper, consists of seven distinct operations before a print is ready to be mounted. "Blue" or cyanotype paper requires but one; a simple washing in water.

The color of these prints, if properly made, is not unpleasant, but, on the contrary, is quite attractive, and collections of photographs interspersed with them offer a very attractive variation.

Like the ready-sensitized chloride of silver paper, the cyanotype paper has become an article of trade, and is manufactured and sold in enormous quantities, cut up into sizes to corre-

spond with the negative plates made with the cameras of the American Optical Company and other manufacturers.

All that is necessary to produce a blue print is to bring the prepared side of the paper into absolute contact with the negative, expose to light, and wash.

Besides being able to make a blue print, the student should learn how to prepare the paper, and become acquainted with the conditions required to produce a sensitive and durable article. In the first place, a paper of any fine texture, free from any chemical bleaching agents or their antidotes is wanted. There is none so well adapted for this purpose as the "papier Saxe" or the "Rives." Its sizing is quite important, and although the ordinary commercial paper answers quite well, it is advisable to give it a stronger body, by immersing it in albumen beaten to a froth, and allowed to settle again for the separation of the clear liquid. Four parts of water mixed with one part of the clarified albumen is a good proportion. After leaving the paper in this mixture for a minute, it may be hung up to dry spontaneously, and the albumen may be coagulated by placing the paper in a steam chest or by hanging it up near a very hot stove.

For sensitizing the paper we prepare two solutions:

A.—Citrate of iron and ammonia.....1⅞ ounce.
Water.....8 ounces.

B.—Red prussiate of potash.....1¼ ounce.
Water.....8 ounces.

Filter and keep separate in the dark-room. Before use, equal volumes of these are mixed together and poured into a flat dish or tray. After all foam or air-bubbles have disappeared, the paper is floated upon this solution for three minutes, observing the same precaution required in silvering albumen paper. Then hang up to dry.

All this is done in the dark-room, or in a much subdued light. When dry, the paper is printed at once, or it may be preserved for future use. If intended to be kept for a length of time, the pieces of the required size are best brought into close contact with each other, wrapped up in waxed or paraffin paper

and subjected to a slight pressure. This is done to prevent moisture or impure air from coming into contact with the sensitive surface, which would speedily change the original greenish-yellow color to a muddy greenish-blue, denoting a chemical decomposition. Paper having undergone such a change is not easy to print upon. It prints slow, for it has lost much of its sensitiveness, the shadow parts of the negative do not print out in detail, and to obtain pure whites is quite impossible.

The mode of printing being the same as that upon other sensitive substances, requires necessarily absolute contact. Printing in sunlight is advisable, and the operation should be carried far enough to give the darkest parts, that is, those under the clearest parts of the negative, a decided reddish bronze color. When completed, the print is removed from the press and washed in pure water, till the picture is perfectly developed, and stands out with a beautiful blue tone upon a white ground.

When the water dripping from it ceases to be of a yellow tinge, the operation is completed, and the result is a permanent and durable picture which is not affected by light and but little by atmospheric influences.

A few drops of hydrochloric acid intensifies the blue color, and a little sulphuric acid gives it a greenish tint. Ammonia gives it a purple color, and renders the picture lighter, and can be used, therefore, to reduce a print if too dark.

Blue paper is extensively used for the reproducing of tracings and drawings. The copies are naturally negatives, that is, the black lines of the original appear white upon a blue ground. Although the general effect of the picture is thus reversed, blue-printing has found just in this particular line its most extensive employment.

The tourist, anxious to see a proof of his negative, can judge of its general qualities when printed upon cyanotype paper without resorting to the troublesome silver printing and gold toning; and many amateurs are so partially inclined toward blue prints that they even admit them to their albums.

Efforts have been made to convert blue prints into prints of other colors, especially those of dark brown or black shades,

but they have, according to all reliable authorties, signally failed. An old method for changing color is to bleach the blue by means of a carbonated alkali, leaving upon the paper a deposit of sesquioxide of iron, which is afterwards developed with tannic or gallic acid. Clear whites it is almost impossible to obtain, and the general tone of the transferred print may be acceptable to some, but it certainly is not to the general public.

Red prussiate of potash, in substance or in solution, is sensitive to light, and should, therefore, be kept in the dark.

The citrate of iron and ammonia is very hygroscopic, and when exposed to air attracts so much moisture that it will be decomposed and reduced to a black pulpy mass. We must, therefore, keep it in well-stoppered bottles.

LESSON IX.

PRINTING ON PERMANENT BROMIDE OF SILVER PAPER.

This paper, entirely different in its preparation from those we have already become acquainted with, is extremely sensitive to light, and requires, therefore, but short exposures. The mode of operating is not the same, nor similar, to any of the sensitive papers which we have considered, and requires an essentially different treatment. The picture is not secured by a complete printing-out, but by development conducted as in the negative processes, and with chemicals not described in previous instructions.

The uses of the bromide paper are almost unlimited in their variety.

For making contact prints from negatives of all kinds, portraits, views, interiors, architectural and mechanical subjects, it is unsurpassed, both for quickness of execution, and artistic effect. The pure, soft black and gray tones, and steel engraving effects obtained, and the absence of the conventional glossy surface, usual in photographs, are points in its favor that are appreciated by artists and connoisseurs of refined taste.

For copying patent office drawings, engineers' and architects' plans, it surpasses all other processes in quickness and quality of result. It is used by botanists for making copies of leaves, etc., by contact printing.

It is invaluable for use in meteorological and astronomical recording instruments. In making quick proofs from wet negatives, it enables the photographer to see his result without waiting for his negative to dry.

But perhaps the most important application of permanent bromide paper is to the process of enlarging, *i. e.*, the making of large positives from small negatives.

Owing to its great sensitiveness, it will receive and retain an image projected upon it by means of an apparatus similar in principle to a magic lantern, thus enabling the photographer to make prints of any size from small negatives. Such prints present the effect of fine crayon drawings, at the same time retaining the photographic fidelity of likeness and detail.

The exposure required for this extremely sensitive paper varies with the intensity of the negative, and the quality and intensity of the light, but may be approximately stated to be, using as thin negatives as will make good prints, one-quarter second by diffused daylight, or ten seconds at a distance of one foot from a No. 2 kerosene burner. Very thin negatives should be printed by weak yellow light, like that obtained from a kerosene lamp turned down a little below the normal intensity. In this way a strong, vigorous print may be obtained from a negative that would otherwise be too thin and flat. Strong, intense negatives are best printed by daylight.

Permanent bromide paper is manufactured in various grades of sensitiveness and surface. For contact printing of proofs, for drawings, tracings, or those from ordinary negatives, the Eastman "A," with smooth surface, is best adapted; while for enlargements, especially when to be finished by the artist's hand, the "C," of rougher grain, is preferred. All of the different grades are sold cut in popular sizes, and put up in light-tight packages, or in endless rolls, well protected against the action of undue light. For contact printing the paper is laid in the printing frame upon the negative as heretofore described, and for enlargements is fastened against the easel, to be explained later on. Owing to its gelatinized surface, the edges of the paper curl on the coated side, and to make the developer take freely to it, immersion in water becomes necessary before development. When perfectly flattened out, the water may be poured off and the developer applied.

Formula for Developer.

1.—Oxalate of potash.....1 pound
Hot water.....3 pints

Acidify with sulphuric or citric acid. Test with litmus paper.

2.—Protosulphate of iron .....1 pound
Hot water.....1 quart
Sulphuric acid (or citric acid, ½ ounce)..... ½ dram

3.—Bromide potassium..... ..... 1 dram
Water..... 1 quart

These solutions keep separately, and mix only for immediate use.

Take in a suitable tray: No. 1, six ounces; No. 2, one ounce; mix in the order given; use cold.

The image should appear slowly, and should develop up strong, clear and brilliant. When the shadows are sufficiently black, stop, pour off the developer, and flood the print with the clearing solution, consisting of one-quarter of an ounce of citric acid to one quart of water. Repeat washing with the acid water three or four times, rinse well with pure water, and finally fix in hyposulphite of soda, three ounces of which is dissolved in one pint of water. When perfectly fixed, which takes about ten minutes, wash again, submit to the alum-bath and final washing, which is greatly accelerated by the use of Flandreau's hypo eliminator, as in the case of other kinds of prints.

Remarks on Development.

The developer in use is termed by photographers the "ferrous oxalate" developer, and consists in reality of the ferrous oxalate dissolved in an excess of oxalate of potash. The mixture should present a clear, dark-ruby color. If turbid, too much of the iron solution has been added, and the iron oxalate formed is in excess, the oxalate of potash present cannot keep it in solution, hence a part of the iron salt remains undissolved, and precipitates in the form of a bright yellow powder. Such developer is unfit for use.

Care should be taken to employ oxalate of potash only when in a perfectly neutral state, or when acidity is slightly prevailing. An oxalate, reacting alkaline, tends to make hard and chalky prints without half tones, effects erroneously ascribed at times to under-exposures. The only difficulty occurring with bromide prints, is a misjudged time of exposure. Over and

under-exposures can be observed with the ferrous oxalate developer in the same way as by the effects shown in the negative process with pyrogallic acid. Under-exposure gives hard, black and white prints without any half tones or fine gradations.

For over-exposures we have remedies on hand by which we can counteract their effects. One of these is Bromide of Potassium Solution No. 3, which, when judiciously used, will restrain the forcible action of the developer, and modify the gray tone resulting without it.

Too much of it, however, tends to make a yellowish or olive green tone which is by no means agreeable. With a careless application of bromide of potassium there is danger of spoiling the print entirely.

A better restrainer is undoubtedly a developer prepared some time previous to its use, and when it has attained partly to a higher state of oxidation. Whenever an over-exposure may be suspected, it is advisable to commence development with this partly oxidized solution, and when the general outlines and deeper shadows of the picture are fairly out, substitute for it a freshly-made preparation, and counterbalance its action, if too forcible, again with the old. The operation probably requires a little more nicety than the ordinary method, but the resulting tones are decidedly better and richer than those resulting from an excessive use of bromide of potassium.

The office of the acid clearing solution is to dissolve the iron salt that has entered into the pores of the paper supporting the gelatine film during the development. Without it the prints would be of a yellowish, muddy color, wanting in the brilliancy and clearness for which bromide prints are noted.

Permanent bromide prints should not be dried between blotters like albumenized paper, but should be hung over a line, or laid back down upon glass or clean paper.

Enameling.

Squeegee the wet print, face down, on a polished piece of hard rubber or ebonite; when dry the print will peel off with

a fine polished surface. The print should be slipped on to the rubber plate under water to avoid air bubbles.

Flexible Prints.

Permanent bromide prints soaked in a mixture of glycerine, five ounces, and water, twenty-five ounces, and dried, will not curl, and may be used for book illustrations, unmounted. The heavier papers, "B" and "C," are especially adapted for this purpose.

After drying, prints may be straightened by the scraping action of a sharp-edged ruler applied to the back; the corner behind the ruler being lifted as the ruler is passed along.

The operation of enlarging on permanent bromide paper involves the same principles as those underlying the making of a negative; it is simply photographing on a large scale the negative instead of the original. To avoid the necessity of using a large camera, the dark-room itself is made to take the place of the camera body, and the negative is placed in an opening in the dark-room shutter so that all the light will come through it to the lens, as in Fig. 1.

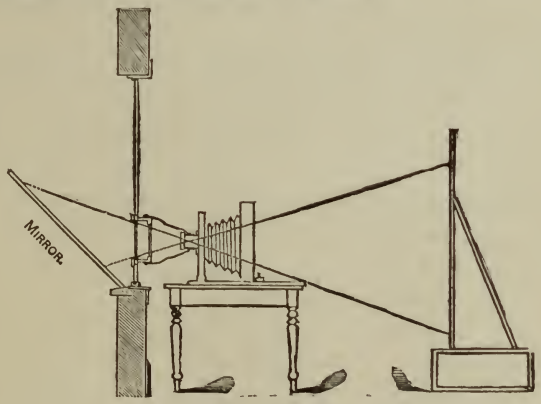


Fig. 1.

This cut represents an enlarging apparatus that any photographer can improvise from ordinary apparatus and material, with the expenditure of a few hours' time. To construct it proceed as follows:

Cut a hole in the dark-room shutter two sizes larger than the largest negative to be enlarged from, fit into the opening a frame about two or three inches deep, glazed on the outside with a sheet of ground-glass. On the inside edges of the frame, top and bottom, arrange grooves in which to slide the negative; when the negative is in position it will be brilliantly illuminated against the ground-glass. Now, on a table or shelf, adjusted in front of the negative box, place an ordinary camera having the ground-glass removed, point the lens toward the negative, and connect the lens and negative box by means of a bag of opaque cloth, open at both ends and provided with elastic bands to close it tightly around the lens and negative box. This will prevent any light from coming into the dark-room, except that which passes through the lens. (See Figs. 1 and 2).

In this apparatus the camera body serves no useful purpose; all that is required is to support the lens. In case a portrait lens is used, it should be put in position so that the back lens will be next the negative instead of as shown in the cut.

The easel to hold the sensitive paper is the next requisite, and this may be constructed by fastening a large, flat board in an upright position, upon a box of suitable size, to serve as a base, so that the whole may be moved to and fro to regulate the size of the enlargement. The face of the easel should be covered with white paper. Now, if the easel is put in position, facing the camera, the image can be focused on the screen by sliding the camera backward or forward on the shelf.

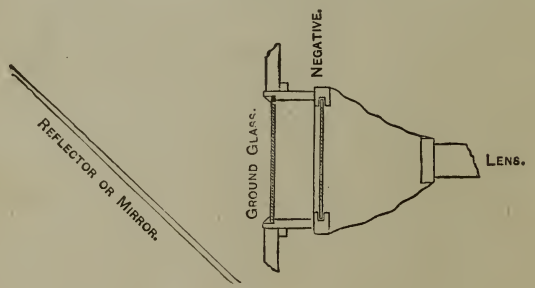


Fig. 2.

The size of the enlargement will depend upon the length of

focus of the lens, and the distance the easel is set from the negative.

Any lens that will make a negative can be used for enlarging, and the proper size for the lens depends wholly upon the negative to be enlarged from, and not at all upon the enlargement to be made. If the lens will cover the negative, it will make an enlargement from it of any size.

For enlarging from negatives 5x8 inches and under, a half-size portrait lens is suitable. It can be worked nearly wide open for heads, but must be stopped down for half and full-length figures. Rapid rectilinear lenses are also suitable, but, of course, do not work quite as quickly on heads as portrait lenses, because they have not as large apertures. For full and half-length figures and views they are quite as rapid, because, for this purpose, the portrait lens requires to be stopped down as far as the rapid rectilinear.

Hints.

Mealy Mottled Prints.—Over-exposure and short development.

Greenish Tones are obtained by over-exposure and too much bromide.

Forcing Development does not give good results for the above reason.

Face of Permanent Bromide Paper can always be distinguished by its curling *in*. Convex side is always the back.

Fixing.—The operator can tell when a bromide print is fixed by looking through it or upon it in a good light; unfixed portions will be greenish yellow.

Yellow Prints.—Prolonged development will cause yellow prints by depositing iron in the paper. The exposure must be correct, so as to allow of quick development.

Running Water is not so sure a means for washing prints as changing them from one tray to another, allowing them to soak at least ten minutes in each fresh water; twelve changes are sufficient; no less.

The Permanency of Bromide Prints.

It should be understood that a print on permanent bromide paper is a very different thing from an ordinary photograph on albumen paper. In the first case, the image is produced by development upon a substance containing *no free nitrate of silver*. In the second case, the image is formed by light alone acting upon an organic compound of silver in the presence of free nitrate of silver; in this case the image is known to be unreliable as to permanence, while in the case of the permanent bromide, all the evidence points to as great a permanence as can be desired.

LESSON X.

ARTISTIC PRINTING.

But a little time has passed since the primitive amateur photographer thought his duty done by exposing his ready-made dry plates and leaving to a "professional" the labor of developing and printing. He has since discovered that his own developing and printing are quite as essential as the mere exposure, in order to reproduce the picture which he had in his mind's eye.

On the proper development of correct and faulty exposures, former lessons have given instructions. The following remarks are intended for those, who, having mastered plain printing, desire to have some knowledge of more artistic methods, viz.: I. Of Printing in Medallion Style; II. Vignetting; III. Flushing or Tinting the White Back-ground; IV. Combining I. and II.; V. Printing in Back-grounds; VI. Printing in Clouds.

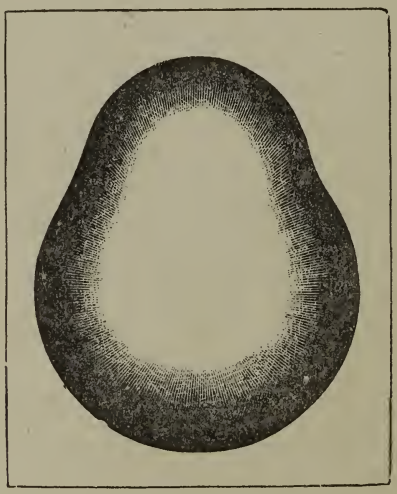
Printing in Medallion.

In order to print portraits in *medallion* style it will be necessary to procure some metal oval and circle guides and a revolving Robinson print trimmer. It will be desirable to have at least two sizes of the guides for the carte de visite and two sizes for the cabinet form. Cut a suitable mask on orange post-office paper and paste it on the face of the negative. This will give you in printing an oval or circle with a white border. In order to tint the border, paste the cut-out oval on a clean glass of suitable size. Place your print on another glass, adjust the "cut-out" face down over it and expose to light, more or less according to taste. The tinted border may be orna-

mented in various ways by a piece of tulle or lace stretched over it, etc.; but the plain tinted border will be the most satisfactory on the whole.

For Vignetting Portraits.

It is desirable that the original should have been taken against a light (not white) back-ground. If the back-ground be too dark, it must be lightened artificially, as *f. i.*, by covering the glass side of the negative with ground-glass varnish and darkening it with a stump and black lead, beginning close to the head. Next, cut out a mask close to the figure; for a portrait the pear shape will be found most suitable. Cut the mask, not in straight, but in irregular wavy lines, similar to the cut of Weymouth's vignetter. Cover your printing frame



with a stout card-board into which a square or an oval opening is cut out, large enough to receive any size of masks. This opening is to be covered with a piece of tissue paper of even texture. Underneath this paste your mask and back the whole on the printing-frame, the tissue paper uppermost, next to the light. Adjust the negative in proper position, looking through against the light; if a greater number of prints of the same

negative is desired, paste the negative in proper position by means of some strips of glued paper. If, after printing a proof, the gradations of the vignette should prove too abrupt, it may be remedied by (1) widening the space between the negative and the mask; (2) by painting on the glass side of the negative, with Russian or indigo blue, a contour in waving outlines according to taste; (3) by encircling the head with loose cotton wool, always on the glass side of the negative.

Flushing.

Flushing or tinting the white back-ground of a vignette will be of advantage in prints from flat negatives. The dull lights in the print will be enhanced by subduing the extreme white of the back-ground. The easiest and safest way to do this is to cut out a mask slightly smaller than the head and figure (omitting the shadows caused by the vignette printing). Place the print into a printing-frame, and over the glass outside you mask and expose to light, moving with a darning-needle (which hardly throws any shadow), waxed on one end in order to get a tack on your cut-out mask, moving it slightly during exposure.

Combination Printing.

A combination of the vignette, plain or tinted, can then be made with the medallion style, for which no further instructions need be given.

Taste, and the quality of the negative, must guide the printer to decide which of the described ways of printing will show the subject to best advantage. A child's or a very young lady's head will show best closely vignetted on a white back-ground, while a gray head with whiskers will be most effective on a plain, dark back-ground.

Printing-in Back-grounds.

Printing-in back-grounds, either natural or artificial, for portraits or groups, is a more difficult subject, and will require some experimenting before success can be attained. The

mode of operation consists (1) in obliterating any back-grounds of your figures by the use of any opaque color close to the figure or figures, and in printing them in proper position; (2) in choosing a back-ground which is lighted from the same side as the figures; (3) in cutting out masks of the figures slightly smaller than the originals. Now place your foreground negative into the printing-frame and your figures over it and close. Cover outside of the glass of the printing-frame the figures with your cut-out mask and expose to light, moving the mask as before directed. The degree of intensity of the back-ground must be examined from time to time in order to get perfect harmony of tone between figures and back-ground.

Printing-in Clouds.

Printing-in clouds into landscape photographs. A landscape photograph, be it ever so successful, with a clear blue (in photography, a white) sky, is but a half-finished picture. To give animation to the blank space, especially when the horizon is low, it will be necessary to enliven it with cloud-life.

Secure on a favorable day cloud-negatives from some elevated point, tilting the camera upwards in order to get the greatest amount of sky on your plate. Avoid over-developing, as it is desirable to have quick-printing negatives. Mark them according to the exposure, scratching in some corner S. M., south morning; E. E., east evening, etc. Do not hesitate to point your lens direct against the sun, especially on fine sunset evenings; the transparent spot of the sun disc is easily blocked out by a circular cut-out opaque paper, somewhat larger than the sun disc, gummed on the glass side of the negative.

Having thus obtained a number of cloud-negatives suitable in lighting for any of your landscapes, the difficult part remains of printing them into your picture without showing a dividing line. Proceed as follows: Make a mask of your landscape on some opaque paper (post-office paper will do), tracing the outlines of the horizon in a rough way, not minding single tree tops rising above it. Place your print over the selected cloud-negative in a printing-frame, and your mask outside of the frame in position. Expose to the sun,

constantly moving your mask up and down, also sideways; never hold your mask too high above the horizon point, but rather move it an eighth of an inch or so below. As it is easy to observe, from time to time, the effect of your printing, you can manage the mask, raising it higher, lower, or cornerwise, according to requirement. The result will be, after a little practice, a perfect blending of the two negatives.

It will be advisable to secure cloud-negatives on larger plates than those used for the landscape. By placing the print in different positions, a variety of cloud effects can be obtained from the same cloud-negative.

In conclusion, let us warn the young photographers never to print the full size of their negatives when they use lenses of very short focus, as *f. i.*, the wide-angle lenses, for the reason that only about two-thirds of the center is in true perspective and the borders outrageously exaggerated. Even with negatives made with long-focus lenses it will be advisable to make some sacrifice for the benefit of a more artistic result. The printing of landscapes in medallion and vignetted form give most charming effects, and many a faulty negative may yield excellent results by this mode of treatment.

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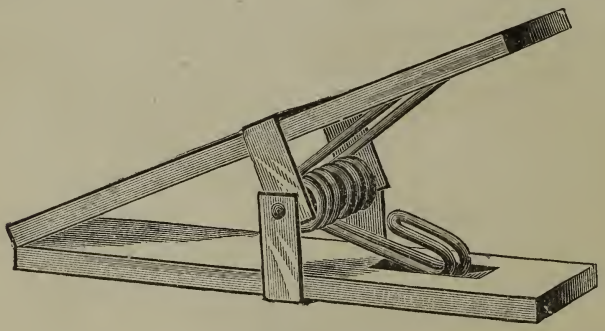
LESSON XI.

TRIMMING AND MOUNTING THE PRINTS.

Trimming.

The albumen prints, having been thoroughly washed, and the last traces of hypo having been eliminated from them, they may be dried and trimmed or cut to appropriate sizes and shapes preparatory to mounting. For economical reasons, many photographers trim their pictures before toning and fixing, and collect the paper clippings containing small amounts of silver, to recover by chemical processes the precious metal.

Prints should be dried spontaneously, and not by heat. They are hung up two by two and back to back with clips and strung on a line.



Lockwood's Clip.

The trimming of the photograph should always be neatly and carefully done. The edges should be untorn and the form or shape should be true. A knife is often used with a glass or metal form, but the invention of Mr. S. M. Robinson, known as the Robinson Trimmer, has almost displaced the knife. These trimmers are made in two forms, the one illustrated by Fig. 1 being constructed so as to revolve in a socket in order

to follow accurately an oval or round-cornered metal "guide," and the other, in Fig. 2, known as the "straight-cut," is for trimming straight edges, a metal guide being used with it also, or a glass form.

The theory of these trimmers is that instead of cutting they pinch off the surplus paper, thereby giving a nicely bevelled edge to the print, and they are far superior to the knife or scissors, if held or used as indicated in the drawings.

To trim the print well it must be laid upon a hard surface. Many use a glass, others again trim upon a sheet of zinc. With the former, the cutting tool is very soon dulled, and with the latter, the metal is cut up and roughened so much that a clean cut soon becomes an impossibility. A better mode is to paste a sheet of well-sized paper on the glass, which, when dry, gives sufficient resistance to the trimmer without injuring its sharp edge, and the surface, not being so slippery as glass, allows the print to rest well upon it during the manipulation.

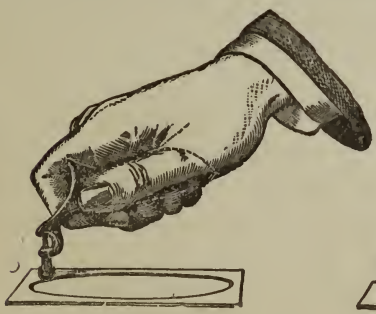


Fig. 1.

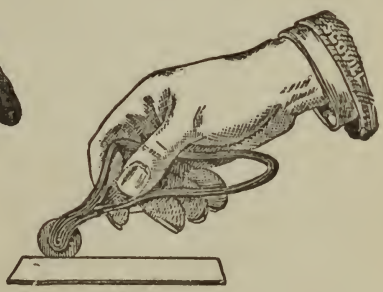


Fig. 2.

Robinson's Trimmers.

Before mounting, the prints are wetted again in clean water, and when perfectly pliable laid upon blotting paper in several thicknesses face down, and piled upon each other in such quantities as to allow of convenient pasting.

Mounting.

A very durable and adhesive mountant is the S. P. C. parlor paste.

Another good paste, easily made by anybody, is the following:

Good laundry starch	1¼ ounces.
Sheet gelatine or white glue	80 grains.

Put the starch into a small pan, add one ounce of water, and mix thoroughly with a spoon or the ordinary mounting brush, until it is like a thick cream, then add fourteen ounces of water and the gelatine, broken into small fragments. Boil for four or five minutes, set aside until nearly cold, then add one ounce of alcohol and six drops of pure carbolic acid. We have now fifteen ounces of a very good and durable paste that will keep well, in stoppered bottles, is smooth as cream, and without lumps or grit.

Previous to applying the paste all superfluous water is squeezed from the pile of prints with a slight pressure between blotting paper, after which the mounting can be commenced. A flat bristle brush is dipped into the paste, and then drawn with slight force over the print laying on top of the pile. It is drawn several times, and in opposite directions, over the back of the print without leaving more paste than is necessary for adhesion. The print is then lifted up with the point of a knife, and placed in proper position upon the mount. With a stout piece of paper and an ivory paper cutter, or similar tool, the the print must be laid flat, all air bubbles expelled from under it, and when adhering uniformly to all parts of the mount, laid aside for drying, with the face side down. Care must be taken to apply no more paste than is needed to fasten the print to the mount. Highly glazed mounts, at present so much in vogue, are, on account of their greasy enamel, quite difficult to mount upon. To make photographs adhere to them uniformly, it is best to add, and mix well with the fifteen ounces of paste, one-half ounce of ammonia. A part of the ammonia saponifies the greasy matter, the rest evaporates. The method is very easy to work, and is not injurious to the picture.

Blue prints and photographs on plain paper are similarly mounted, but do not require to be wetted; it is probably better to paste them when in a dry state.

Permanent bromide prints may be mounted wet or dry; the

prints should *not* be dried between blotters like albumenized paper, but should be hung over a line, or laid back down upon glass or clean paper. To mount, brush over the back some thin starch paste, lay the print on the mount and rub into contact with a soft cloth.

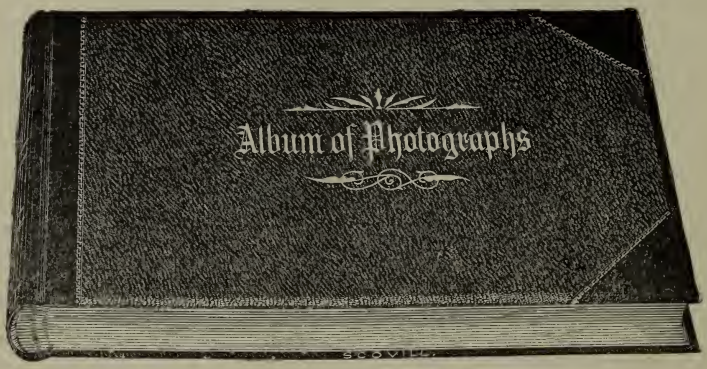
For very large pictures, cover an artist's stretcher frame with a piece of common white muslin, by stretching it tightly, while dry, and tacking it on the outside edges. Give the cloth a coat of starch paste, rubbing it well in and avoiding streaks and lumps, lay over a smooth table a piece of rubber sheeting, lay the wet print on the rubber cloth, face down, and with a rubber squeegee scrape off the water. Give the back of the print, as it lies on the rubber cloth, a coat of paste, and then lay the stretcher, face down, upon it, and rub the muslin into contact with the back of the print, using a thin paper-knife to reach under the edges of the frame. Lift the frame and rubber cloth from the table together, and peel the rubber off from the face of the print. This will leave the print on the stretcher smooth and flat. When dry it will be tight as a drum head.

Albumenized and other paper photographs may be mounted on muslin similarly. Should it be required to mount them back to back with a muslin support between them, trimming had better be deferred until after mounting and drying. The muslin should, however, be well stretched.

To prevent mounted pictures of large dimensions from curling up, the mounts should be dampened before the pictures are laid upon them. They are then dried between blotting-paper and under a slight pressure, the blotting-paper being changed occasionally.

To mount in an album without cockling, let the photograph be ironed with a hot iron on the back till it is perfectly smooth, then place it under pressure till quite flat. A large book answers the purpose admirably. To prepare for mounting, lay the flattened print face downwards on a smooth board or piece of glass, and upon it place a piece of clean, stiff paper, an eighth of an inch less all round than the photograph, upon the exposed edge of which rapidly and sparely brush some liquid glue (as little as possible) to cover it. Herein lies the secret.

Avoid making the paper wet. The album being conveniently placed—the position the photograph is to occupy being previously marked with a pencil—carefully raise the photograph with a point of some kind, to avoid soiling the fingers with the



THE ALBUM.

glued edge making it non-adhesive in the parts where such glue would be removed, and lay it down in the proper place. At once lay a piece of clean paper over it, and rub it down firmly with a soft rag, and close the album. In half an hour the face will be dry and the print perfectly flat, and it will remain so.

LESSON XII.

SPOTTING AND BURNISHING THE PRINTS.

Spotting.

Careless or excessive negative retouching, faults or impurities in the glass supporting the gelatine film, foreign matter which has accidentally found ingress between negative and paper during printing, dirt upon the surface of the negative plate, and a variety of other causes, produce white spots of unexposed paper on albumen prints. These faults or spots must be taken out or touched away by an operation termed "spotting," by photographers.

Simple as the operation may appear at the first glance, it requires, nevertheless, a steady hand, an eye well educated to judge correctly of color, and some mechanical skill. Only the white spot should be covered with the retouching medium, and its color must harmonize strictly with the general tone of the photograph. If the spot is large, interrupting different shades, the touching must be done in such a manner as not to break up the harmony, or to present tones in variance with its surroundings. With "blue" prints or those on plain paper it is comparatively easy to do this. Albumen paper, on account of its gloss and hardness, repels aqueous colors and India ink, and the paint or color must be prepared to work easily on the paper.

Take

Gum arabic	10 parts.
Glycerine	1 "
Alcohol	5 "
Water	34 "

Dissolve the gum in a mortar by rubbing it well with the solvent, add the other ingredients, mix well, and keep in a well-stoppered bottle.

Take, further, a half-part of dried and pulverized ox-gall and mix well with ten parts of the above solution.

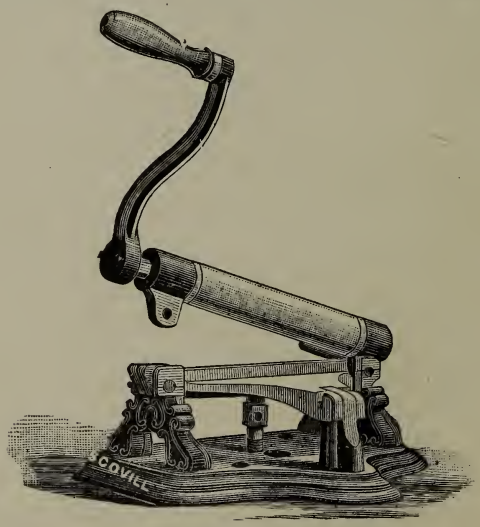
A mixture of neutral tint, carmine and Prussian blue, can be made to match any photographic tone. Such a mixture combined with the ox-gall preparation is eminently useful for retouching or spotting out albumenized paper prints. A fine camel's-hair brush slightly moistened with the color solution will do the work. For larger spots washing may be employed, but it is better to do the work by stippling.

Bromide prints are best spotted with a very soft lead pencil, Faber's BBB.

Burnishing.

The very high polish on photographs, now so popular, is attained by propelling the picture over a heated burnishing tool contained in a little machine constructed especially for the purpose.

The burnishing tool should be uniformly heated, and this is done either by two or three alcohol flames, or by gas passing through a perforated tube, which is attached to the ordinary gas-burner by means of a rubber tube. Petroleum or oil lamps must never be used, as by any imperfect combination of the fuel, carbon is separated in the shape of smoke or soot, which will soil the picture and the hands of the manipulator.



Burnisher.

Preparatory to burnishing, the mounted, dried and spotted

print is lubricated, to promote its free and uninterrupted passage over the tool. This is done by rubbing over its face an alcoholic solution of Venetian or Castile soap, or finely-scraped solid soap.

A print to be burnished should not be dried too much, as the swell of the card bends the picture backwards. Let the picture dry until the contraction of the paper just commences to bend the picture forwards. It will be found that the picture in this stage is about three-fourths dry, and it is absolutely necessary that it should not be allowed to dry any further until after it has gone through the burnisher.

This is best done by arranging the pictures in one or two piles, and placing them under a weight. They should be carefully taken from the pile and spotted out, and immediately placed in another pile under a weight. The same precaution should be taken in applying the lubricator to the print. The reason for this method of procedure will be evident to anyone who has observed with what a number of irregular lines the surface of a picture becomes broken when allowed to become perfectly dry in the usual manner. When these marrings have once appeared in a picture, there is no method for again uniting the broken surface. When burnished by the above directions, the picture will be found to be very compact and hard when cool, and neither alcohol nor water will destroy the gloss thus obtained. It is advisable to put, first, the picture through the burnisher lengthways, curling it up backwards around the roller; afterwards put it through sideways, thus straightening it, and thereby also raising a much higher polish.

If, occasionally, a cabinet or card picture will not take the gloss, breathe upon it freely before running it through the burnisher. Should the enamel not be produced the first time, repeat the operation after the picture has become cool; the desired result will then be obtained.

It is imperative to keep the burnishing tool in a good condition. Rust or scratches are its greatest enemy, and if they should occur, a re-polish can be given to the burnisher by rubbing it well with an oiled leather file and the finest emery flour.

Unmounted photographs are often required to be burnished. The trimmed and spotted picture is lubricated as usual, laid smoothly upon an ordinary card-board, larger than the print, in the same position as if it had been mounted thereon, and passed over the tool. The manipulation does not differ from that of mounted prints, but care must be taken not to allow the print to slip from its position.

When mounted on muslin, the burnishing of prints is quite easy, but it is advisable to place a card-board between the rough roller and the print, so as to prevent an impression of the corrugated surface of the muslin. When burnishing prints that are mounted back to back, either with or without paper or muslin support between them, the card-mount protector must again be employed; burnishing the one side of the double print first, then the other in the usual manner. Often pictures are seen which present a much higher and more beautiful gloss than can be obtained with the burnisher. These are called "enamels" or "glacés." The method of enamelling is a little more complicated, but nevertheless is quite easy. It is done in the following manner:

Enamelling.

Sprinkle the surface of a glass plate with powdered French chalk, rub it evenly over the surface with a tuft of cotton wool, continuing to lightly rub it until the chalk is all removed, then coat the glass with the following

Collodion.

Soluble gun cotton	48 grains
Alcohol	4 ounces
Sulphuric ether	4 ounces

As soon as the collodion is well set lay upon it the print, previously soaked in a warm solution of one-half ounce gelatine in ten ounces of water, to which a few drops of glycerine have been added. Expel all air bubbles from beneath the print and squeegee it into absolute contact with the collodionized glass.

After drying, the print can be peeled off from the glass and the face will present a polish almost as high as the surface of the glass from which it has been removed. The print is then

ready to mount, as follows: Moisten the face of the mount with a damp sponge and lay upon it the pasted print; rub down with a soft cloth and put under pressure to dry.

The addition of five per cent. of glycerine to the paste will prevent the print peeling off the glass as it dries.

For enamelling bromide prints the same collodion substratum as mentioned above may be employed.

As soon as the collodion is well set, slide the plate face up into a tray of water, in which is floating, face down, the permanent bromide print, which has just been fixed and washed; grasp the plate and print by one end and lift together from the water, avoiding bubbles and draining the water from the opposite end; squeegee the print into contact with the plate and set away to dry. Before the print is quite dry apply a coat of starch paste to the back.

Another method is to squeegee the wet print, face down, on a polished piece of hard rubber or ebonite; when dry the print will peel off with a fine polished surface. The print should be slipped on to the rubber plate under water to avoid air bubbles.

Cyanotypes and plain paper photographs do not assume gloss so readily under the burnisher as do albumen prints, but they, too, may be enamelled to a considerable extent.

Great richness of tone and depth, transparency and detail in lights and shadows can be given to them with encaustic paste, which secures also their permanency, this paste being a preventative against the action of moisture and injurious gases.

The formula for the paste is as follows:

Pure virgin wax	500 grains.
Gum elemi	10 "
Benzole	200 "
Essence of lavender	300 "
Oil of spike	15 "

Melt the whole thoroughly on a water bath, and strain through muslin. A simpler plan is to dissolve the elemi in the solvents as described, and, after filtering, mix with the melted wax, as the filtration, which is chiefly intended for the gum elemi, is more easily managed before the wax is present. This, when finished, forms a stiff paste. By increasing the

proportion of essence of lavender, it can be made thinner, which in winter may be desirable. The encaustic paste is put on the print in patches in three or four parts, and then rubbed with a light, quick motion, with a piece of clean flannel, until a firm, fine surface is obtained. If a rich, thick coating of the encaustic be desired, a very light pressure in rubbing is necessary, so that a polish may be acquired without rubbing off the paste in the operation. If a print is retouched, more care must be taken to use the hand lightly in applying the paste.

Finishing a photograph properly is of as much importance as the developing or printing of it. A badly mounted, spotted or burnished picture may spoil all the good work previously done, and the tyro must, therefore, never neglect to give the final manipulation his undivided and careful attention.

LESSON XIII.

PORTRAITURE.

This important and most difficult branch of photography can hardly receive sufficient attention within the short space of a Chautauqua lesson. A mere outline only can be given to the student in describing the construction of the studio, or the uses of back-grounds and accessories, the lighting and posing of subject, or the arrangement of groups; although this should be considered in more detailed form. It is impossible to give concisely all that upon which innumerable artists have written volumes with more or less success.

Before any degree of proficiency can be attained, art-photography requires much practical exercise, close observation, and diligent reading. It is, therefore, advisable to supplement the studying of this chapter by the reading of a good book on the subject.*

The studio or skylight room must be of first consideration. It is well to have plenty of space to move about in and to contain the necessary furniture, apparatus, and accessories. The length may be partly determined by the size of the pictures intended to be made, and it will be found that if the room is to be long enough to allow a cabinet portrait to be taken of a full length standing figure with sufficient space for back-ground, camera, and contingencies, twenty-eight feet will be quite sufficient. In width, if we allow enough space for furniture, head-rests, additional cameras and utensils, fourteen feet will give room enough in which to work comfortably.

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* "The Studio, and What to Do In It." By H. P. Robinson (Scovill Manufacturing Company, Publishers). Price, 75 cents.

Various opinions exist among the experts as to the best shape and position of the skylight. There are certain rules and facts, however, which should not be disregarded. Contrast between light and shade is a point of the utmost importance, and the results deriving from their management are obvious. If all the light comes from one point, the contrast will be too violent, whereas two lights, equally strong from opposite directions, will place the subject to disadvantage, destroy contrasts, produce flat pictures, without roundness or solidity of effect. The light thrown on the subject should be diffused and soft. The direct light of the sun must be avoided. It is well to remember that, if the skylight faces east, the rising sun will stream in; a southern light admits the sun immediately before and after noon, while a western light is equally objectionable on account of the afternoon sun. It is only from the north, then, that the direct sunlight can be avoided; hence every skylight should face the north.

It must be borne in mind that a skylight suitable for one style of work is not always the best for another class. Thus a low light is generally better for standing or entire figures, and gives brilliancy to all parts of the picture, while a higher light is better suited for head and bust pictures, it being softer and more subdued. Therefore, it is an essential point to so construct a skylight as to adapt it as near as may be to the producing of general work. When it is impracticable to have a side light, the top light should have considerable slope, and thus give different heights, but when it is practicable, top light should be combined with a side light. The side light should rise in an elevation from thirty to thirty-five inches above the floor, be not less than six feet and not more than eight feet high, and not less than ten feet and not more than twelve feet long. The top light, rising from the side light at an angle of 35 deg., should be of the same length as the side light, or one-fourth more.

At certain periods of the year, when the sun reaches a high elevation, its rays will be apt to intrude themselves through the top light, to avoid which, to a certain extent, two poles may be erected, furnished with cross bars, along which a canvass curtain may be drawn.

The sashes should be fitted with white glass, and the panes be as large as practicable to avoid too often repeated lappings.

To regulate light effects at the will of the operator, to concentrate it at some points, to exclude it or subdue it in others, we resort to movable screens or shutters. A plan to be recommended is to provide two or three shades on spring rollers, whose combined widths are the width of the top light, the spring rollers being attached to the highest point of the top light. These may be made of some stiff material, and of a light neutral color; and if a double set of curtains is preferred, the other can be of thin white muslin. The side light may be curtained similarly, but should be movable from side to side.

The color of the interior of the studio had also best be of a light neutral tone. The floor should be level and steady; it may be painted of a light-brown or other suitable color.

Carpets and oilcloth are objectionable for several reasons.

Back-grounds are essential parts of the studio, and should be properly selected. If plain and uniform in tone, the effects produced by them are plain and uniform. A carefully graduated back-ground relieves certain parts of the picture, and contrasts well with others; thus the lights in the figure should be relieved by the darker shades in the back-ground, and *vice versa*. Fancy painted back-grounds are always dangerous experiments, except in the hands of an expert. Absolutely avoid heavy columns, pedestals or balustrades; they rarely contribute to the beauty of the picture. The introduction of a gracefully falling curtain, with good taste and in keeping with the subject, may occasionally be permitted to relieve what otherwise might appear too monotonous, or to form a balance line, which may be requisite.

In the introduction of accessories, such as rocks, stumps, gate-ways, shrubbery, etc., these should be faintly but distinctly reproduced to give life and harmony to the back-ground, representing a landscape or garden scene, with graduated sky of delicate and broken clouds.

For interiors, the back-ground might be in panels of graduated tints; if painted to represent the light streaming in from a casement, be very careful that the light falls on the sitter from the same direction.

The nearer the subject is to the light the stronger will be the shadows. A reflecting side-screen will subdue excessively strong shadows on the face. It should be covered with light gray material, and be placed obliquely towards the sitter, and at a distance to soften the shadows, but not near enough to destroy them entirely.

How to light the sitter can be treated in general terms only. Lighting the subject in special cases is a question which can be solved by the operator alone when the subject is before him. He must see that the light and shade fall so as to produce the most agreeable effect before the sensitive plate is exposed, and with the capacity of seeing this, the power of modifying is usually accompanied.

As a general principle a high side light, a little in advance of the sitter, is the best direct light; excess of vertical light is in most cases to be avoided; nevertheless, it may be useful at times in giving form and brilliancy to flat common-place faces. But where the sitter has heavy brows, sunken eyes, or prominent features, the least possible vertical light should be employed, or these features will look more marked and heavy. With such faces the side light, well in advance of the sitter, will give the most soft and harmonious effect without risk of flatness. The top front light will generally serve to illumine sufficiently the shadow side of the face without having to resort to the reflecting side-screen, which, however, under some circumstances, will not only be useful but necessary. As a rule, a mild and soft light is what is required. Strong illumination produces lights and shadows of much intensity, giving black and white pictures.

There are other influences beside the amount of space through which the light is admitted. The aspect of the day, the period of the year, the quality of light, the situation of the studio, and the quality of the plate; for a very sensitive plate seems to require a greater contrast of light and shade than a slow one.

The true test of good lighting is roundness. This can only be obtained by securing delicacy in the half tones; there should be no broad patches of light and shade, but gradation everywhere. The operator must educate himself to see these half

tones, and he must see them in his model without looking at the ground-glass. Get the right effect in nature and the rest will follow.

A few remarks on the imperfections of the human face may be appropriate.

Every face has, artistically speaking, two distinctly different sides, and it is for the operator to select for his portrait the best view. With gentlemen, as a general thing, the hair is parted on one side, and that side is usually preferred, if there be no reason for choosing the reverse. Often the head is rather bald towards the beginning of the parting; in such cases, perhaps, the opposite side might be preferable. Light yellow or red hair should be powdered, unless a color-sensitive plate is to be exposed.

In cases of a too high forehead, the latter may be foreshortened by raising the camera. Blue and light eyes should, as a general rule, be turned from the light. Deeply sunken eyes require considerable front and very little top light. Where the eye is defective, you will, of course, turn that side away from the camera as much as is necessary, to lose sight of the defect; or even a profile may be taken. Where one eye is smaller than the other, it is generally preferable to take the larger one more prominently. Where one eye is higher than the other, if no other objection offer, take the higher eye. In the case of small and partially closed eyes, make them look upwards, or if desired that the portrait look at you, depress the chin a little. For very large and staring eyes make them look lower.

In a full face the eyes may look straight forward, being careful to turn the body to one side, more or less; never have chest and head presented exactly in front of the camera.

The direction of the eyes is important. Never allow the head to turn in one direction and the eyes in the opposite; nothing can be worse than this. In the case of short-sighted persons wearing spectacles, beware of false reflections. An improperly placed side-screen will reflect so much light that the eyes are entirely obliterated.

In but very rare cases do we find a perfectly straight nose.

If it turn to the left or right, the two sides of the face will appear materially different; when twisted towards the left, a view taken from that side will shorten the nose, apparently, whereas the opposite result takes place from the other side. If the nose be very long take the face rather full. In the case of a turned-up nose, raise the camera as high as possible; with a round and rather flat or fat nose, take it pretty well from the side.

For high cheek bones, with hollow cheeks, be very careful of a too strong top light, and take the face rather full, well lighting up the cheeks. In frequent cases the profile is the better view. Should one cheek be swollen, perhaps it might be better to avoid that side; if not practicable to do this rest the cheek upon the hand.

Old and wrinkled faces require a strong front light without much shadow, and are generally best taken in full, front views.

Small and narrow mouths may be taken rather full; pursue the opposite course with large mouths and fat lips.

It is very difficult to secure pictures of large open mouths with protruding teeth. Closing the lips by force distorts the chin and all chance of obtaining a good likeness is lost. Engage the sitter in conversation and expose the plate when mouth, chin, and cheeks are in the most favorable position.

Full or three-quarter length figures are more difficult to manage than head and bust. A pictorial back-ground may then be employed, and furniture or other accessories appropriate to back-ground and the costume of the sitter are admissible.

For a lady there is nothing better than a simple attitude, without attempt to pose artificially; let the hands join in front, or, for variety's sake, rest one upon a chair or other suitable piece of furniture. Throwing one hand behind the back gives in some positions very pretty effects. When furniture is used to assist in making the position, a piece of lace or nicely folded drapery is of great value to conceal some parts or bring others into better relief. Sitting figures are more easily posed than standing ones; more action can be brought into the picture, and employment can better be given to the hands, thus obtain-

ing life and expression for the whole composition. A fan lends itself admirably to the purpose, so does a book, sewing, writing, or similar employment, answers well.

No difficulty occurs more frequently in portraiture than the posing of hands. Arms and hands should be rather retired, both in position and tone; if they must come in the picture, endeavor to turn the edge of the hand towards the camera, and avoid leaning the arms too heavily against anything which will distort the natural form. Care should be taken that the fingers curve gracefully. Hands appear frequently too large, and to prevent this they must be placed in a plane with the face. In some positions a hand looks much larger than in others. Especially is this apparent when its broad back is seen. When the fingers are interlaced the effect is similar. A well-formed hand is a beautiful object, and while in the composition of a portrait, first consideration is given to the head as the principal object, the second place the artist should give to the hands.

Group pictures are likewise not easily made, and none present so many difficulties as the family group, in which, frequently three generations are represented, thus offering material of various kinds, from which to compose a whole, harmonious in all respects. It is in all cases necessary that each individual of a group should be an equally well-lighted portrait and perfect likeness; and while one of the first art-principles and good taste tell us that one or more of the component parts of a picture should be given prominence, and others be subdued in light-effect, a variety of difficulties here naturally occur. Groups should always be arranged in pyramidal form, and in such a manner that the whole appears to be composed of several minor pyramids. The same refers to smaller groups of but a limited number of persons. For two, let one stand, the other sit; while, in a group of three, two had better be sitting and one standing. By no means should the persons composing a group stare at the camera; let every one of them select a point to look at, according to the turn of the head, and on a level with the eye.

Out-door groups frequently represent a mass of figures,

without any attempt at artistic arrangement. This latter disposition is caused by the impossibility of getting assistance, from the nature of the ground or place where the photograph is taken; but it should be the operator's task to utilize to best advantage the material offered. He should look out for, and take advantage of, any spot that would afford him aid to break up monotony, and to give variety to the general form. A picturesque set of steps often gives such aid in a high degree, and more appropriate appear groups when a motive for the gathering of so many persons is represented in the picture; prominence should be given to the most important persons, and action thrown into each individual and the whole.

In selecting a back-ground, it should be endeavored to secure one with a broad expanse of light, if not too blank. Much detail is objectionable, as it interferes with the figures. The worst back-ground, but the one that is oftenest used for outdoor groups, consists of foliage of large, shining leaves. The effects of the white spots caused by the glittering leaves, especially when out of focus, is very disagreeable.

The introduction of animals is in most cases dangerous. A cat or a dog have often totally spoiled an otherwise quite perfect group.

The photographing of children was, with the old, slow processess, the *bête noir* of the operator. Thanks to the rapid emulsion plate, the young members of society are comparatively quite easily managed now. Posing and lighting them, however, requires, under all circumstances, much patience and perseverance, a tranquil mind, and a certain self-possession, which, unfortunately, is not always displayed by the operator when a young babe is presented before his camera.

To make portraits with limited amateur outfits, and in our own homes, with the command of light emanating from one window only, is easily accomplished. Place your sitter at an oblique angle toward one window of the room, allowing its full force of light to illuminate the subject. To avoid a confusion of light-effects, screen the other window or windows with a white-muslin shade or tissue paper, by which means harmony is established and sufficient illuminating force secured.

If the shadows cast are too abrupt or too opaque, reflect light from the opposite side; a clothes-horse, covered with a sheet or table-cloth, answers quite well for the purpose.

For photographic portraiture, a different kind of lens is constructed, possessing more luminous power, and, consequently, working more rapid than the single landscape lens. Of these, however, we shall treat in the lesson on lenses.

LESSON XIV.

RETOUCHING THE NEGATIVE.

Negatives of portraits, and in frequent cases of landscapes, as well, require certain corrections before satisfactory prints can be made from them. In faces there are wrinkles and heavily-shaded folds to be subdued, warts or scars to be removed, freckles obliterated, broad shadows lightened, and very often whole features to be remodeled. In landscapes, we can assist with pencil and brush to establish better harmony; we lighten up shadows, correct broken lines, add or remove objects, either wanted in the picture or objected to, introduce high lights, strengthen up distances, and, when practical, introduce a clouded sky.

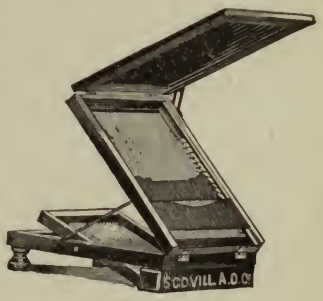
It is the function of the retoucher to improve negatives by judicious and careful work, to give them artistic effects when wanted, but not to overdo his task and merely smooth the plate down mechanically, as the joiner planes down a board. Retouching must be done well, and if the effects aimed at cannot be reached, it is far better to print from an un-retouched plate, with all the objectionable features in it. The retoucher should be a photographer and an artist; that is, he should be able to judge of the quality of the negative to enable him to know where to employ the pencil and where not. He can make a work of art from an average good negative, but he can never be able to render a positively bad negative serviceable for printing. Retouching is an aid in photography, and should never be considered of main importance when making negatives; nor should the operator rely upon the pencil to supply wants that the plate and camera have refused to give.

Therefore, it cannot be laid down too clearly that retouching, even when done by a real artist, should be considered only as a

necessary continuation of very careful work; not that the part of the retoucher is inferior to that of the operator, but that the two should work so well together that the final result will be arrived at through the cleverness of both.

It is not everybody who can retouch well. It is a work requiring a great deal of taste, lightness of hand, close application, and great patience, all of which qualities few people possess. But every photographer is capable of correcting in his negatives some faults which may occur, no matter how skilled as an operator he may be.

The first thing required is an easel on which to work. This should be a piece of fine ground-glass in a frame, on which the negative is placed. The bottom of this frame has hinges as well as the top, which retains a cover of wood kept open by means of small supports, lying on the sides of the frame of the ground-glass. The necessary slant is given to this by means of two other supports, entering at will into some notches on the edges of the surface of a flat and square box, of which the middle is covered by a looking-glass reflecting the light under the negative. Several carriers—same size as the ordinary photographic glasses, and fitting one into the other, completely stop the light around the negative. A little movable rule goes up and down in front of the ground-glass and serves as a rest for the hand of the retoucher. This easel should be put upon a table before a window, with a north light. As there should be no light except that which illuminates the negative, a black blind should be thrown over the top and allowed to fall down closely on each side. There are easels sold purposely, and provided even with wooden shutters, which are kept open by hooks fitting into the top shutter. The retoucher is thus inclosed in a box, and gets no light except that which comes through the negative.



The choice of pencils and brushes is very important, the

great desideratum being one with a rough texture yet capable of taking a fine, hard point. Such an one is the best octagonal black-lead pencil of Faber, which in contrast with many is, as a retoucher once observed to us, "almost capable of doing the retouching itself."

It is desirable to have three or four different degrees of hardness of pencil, so as to suit every class of work, the HH, H, F, and HB being the most suitable. The H is for general work; the HH (the hardest of the four) for very fine and delicate execution and where little labor is required. The F and HB are suitable for heavier penciling when the shadows are heavy and considerable opacity is needed. It is customary to point them in a manner quite different from that usually followed. The lead is laid bare to the extent of almost an inch, and a more or less fine point given to it, according to the negative under treatment.

The brushes should be sable, and very soft. It is very difficult to get good brushes, so they should be chosen with great care. They must be pretty thick, not too long, and with a very good point. All this will be easily found out by dipping them in water and bending them about. If a brush, then, at once makes a fine point, it is a good one.

The two colors most required in negative retouching are India ink and light blue. The first is the most opaque color, but as the latter tint is the nearest to the negative, it will permit of finer work.

Finally, stumps of different sizes, and a very soft camel's-hair brush for dusting the surface during the operation, will complete the list of necessary implements for the retoucher.

Gelatine negatives can be retouched upon without being varnished, although a varnished surface is often preferred. In any case the film requires a previous preparation, to allow the pencil to "take." This is done by rubbing over the parts to be retouched a few drops of the S. P. C. retouching fluid, either with the finger or a small tuft of cotton wool. The fluid should be rubbed in well, but not to complete dryness, allowing a slight cuticle of it to remain, which, after an hour or two, will be dry enough to work upon. After a negative has been var-

nished, the same application can be made, provided the varnish is dry.

The method of deadening the varnish gloss by rubbing over it finely-powdered cuttle-fish bone has been entirely abandoned, as upon such surface the pencil works gritty and irregularly. After having retouched upon the gelatine film, the negative may be varnished, and if, as it occurs at times, certain parts have not attained sufficient opacity, the varnished plate can be retouched over again.

The negative being placed on the frame, as described, the light should be regulated according to its density—the greater the density of the negative the stronger the light required—taking care always to use the lowest degree of illumination consistent with the complete visibility of all detail and half-tone. If too strong a light be used, the retouching will show more forcibly than appears in the negative, and will ruin its delicacy. The aperture in the retouching easel should not be too large, or there will be a flood of light running into the eyes that will not only dazzle and tire them, but render the lighter and more delicate tones invisible.

The pencil is to be pointed in the manner described, the final "sharpening" being given by a piece of emery paper or cloth, a little care being necessary to avoid breaking the long and fine point. The easiest and surest method is to work the point by repeated strokes away from the body, and not to rub it sideways or backward and forward. This hint will be found very useful, as the breaking of half an inch of point is very irritating.

First take out of faces all freckles and marks, blotches of unequal color, etc., and then very carefully make the smallest possible amount of alteration in what is usually termed the "modeling"—that is, softening very heavy shadows and increasing the prominence of some of the leading lights. This is done by delicate "dabs" or dots, so to speak, with the point of the pencil, which must be made of the right intensity at once, as the depth cannot be increased by successive washes of color, as in painting, though if the retouching be done in very fine dotting or stippling, extra depth may be got by carefully filling-in between the first pencilings.

The terms "stippling" and "hatching," as they are often employed, may be briefly described as dotting and lining, respectively. When there are transparent parts requiring a considerable amount of intensity given to them, it will be found next to impossible to do it at once, and then the only plan is to make a first retouching upon the unvarnished negatives as deep as possible; varnish, and retouch again. After the spots are all taken out by stippling, the modeling may be done by hatching, making small lines only, as regular in size and distance apart as possible, and, as much as can be done, causing them to follow the lines or contours of the features, or those particular facial developments that are being worked upon. It is important that the hatching should be done in a regular manner, or a very scratchy and uneven effect will be produced. Great care must be taken to avoid crossing the lines, or make two strokes touch one another, this being a fertile source of "lumpy" or "scratchy" work, as it is forcibly called.

It will be found of great use, if not an actual necessity, to have a magnifier for especially delicate work—not to be made use of from beginning to end, but merely for particular portions of the work, and to aid a general scanning of the whole when completed, so as to pick out any unevenness or roughness. If used all through it causes the work, strange as it may appear, to be less real and flesh-like, and, we might almost say, less delicate. The glass should be of good width, so that both eyes can be used, and it is better if it can be affixed to a permanent support which will hold it at one distance from the negative; and this will materially lessen the fatigue of the eyes in using it.

The hatching may be suitably begun at the forehead and finished at the lower part of the face, working from the highest lights to the shadows, and not *vice versa*. Every face will impart hints as to the leading lights and shadows under varying modes of illumination.

We conclude by pointing out some alterations which may be made or avoided with advantage. One of the commonest faults of a photograph is the stern or "cross" expression so frequently seen, which is caused by a too strong light. One

of the chief seats of this expression is between the eyebrows. It is not caused by the perpendicular line or lines, more or less pronounced, always seen there in persons somewhat advanced in life, but is produced by the contraction of the eyebrow, which at the end nearest the nose will be found, when under this expression, to have taken an angular form, and produced a decidedly darker shadow underneath in the orbit. If the corner of this angle be taken off, and the heavy, dark shadow be slightly lessened, the effect at times is almost magical; and yet any one can see, by looking at a retouched negative, that very few retouchers are aware of this simple expedient, it being generally thought that the upright furrows cause the frown.

The portion of the cheek nearest the nose should be most carefully and thoughtfully done; there is often a delicate shadow which is liable to be taken out by the unskilled retoucher, with the effect of producing a swelled cheek. The line often found running down from the wings of the nostrils should be carefully lightened with the aid of the knowledge which should be obtained by a slight study of the artist's own face in a mirror. The difference between a smile and a sneer is caused by an almost imperceptible difference in the shading of this furrow that cannot be conveyed in words.

And there is the corner of the mouth, where much may often be done if it be borne in mind that in a smile the corner of the lip is slightly turned up, and in a serious, grave or crying expression it takes an opposite direction. The hands may often be improved by taking out the swollen veins they frequently present in the photograph, though it often happens that this can only be done on each individual print.

In landscape negatives, as well as in other negatives, all hard shadows should be softened, and the lights strengthened; but all the work should be done on the back of the glass. In foliage, negatives taken with a bright sun, the nearest trees are often wanting in detail, while the more distant ones are quite sharp. Prints from these negatives have an unpleasant effect, the different lines of distances being too distinctly marked; this may be improved by touching with a brush, not too pointed, and India or blue ink, representing some leaves ac-

cording to the lights which are already indicated. It is impossible to distinguish the trees retouched in this way from the others finely obtained on the negative.

Finally, if there are any strong lights to be put on negatives for obtaining effects of snow, it is best done on the back of the negative, either on tissue paper or white varnish.

The same thing may be done in negatives of clouds which are sharply lighted by sunlight. If the shadows are too transparent, and the lights too hard, put in some half tones, and remove the varnish from the lights. If, on the contrary, the light parts are weak, strengthen them either with a stump or brush, and remove the varnish from the shadows. For positives and enlargements the same work has to be done, and always in the same way.

It will be seen, then, that in the art of retouching negatives it is only in the first step that any difficulty is to be met with, because, being the most important, all the rest follows from it, and is, so to speak, only the same thing differently applied. Therefore, with the knowledge of these few various methods, and a little taste and practice, one may be almost certain of accomplishing good results.

LESSON XV.

PHOTOGRAPHING INTERIORS AND INANIMATE OBJECTS.

Interiors.

During the cold months of winter, when the earth is covered with snow, and the trees are devoid of their foliage, the landscape photographer finds fewer attractive subjects for his camera than in the seasons when nature wears brighter garments, and presents more varied scenes. There are frost and snow pictures, to be sure, and many of exquisite beauty; but they are difficult to find with the camera, and, when discovered, require a peculiar skill in the photographer to be justly reproduced on his plate. At this season of the year, then, to what shall we turn our attention?

Portraits and in-door groups, copying, and the photographing of interiors, at once suggest themselves as suitable and pleasant work for the winter months; and of all these, the photographing of interiors can be pursued with perhaps the greatest real satisfaction and pleasure.

Few are the homes that have not, at least, one room that will make an attractive photograph when properly lighted and arranged. Indeed, the pleasant mystery often is, how so pretty a photograph could be made of "our very plain library." But in a photograph even an ordinary appearing room acquires a certain dignity, and we instinctively think of palace halls and stately mansions.

Especially attractive do one or more rooms appear when seen through doorways or arches, with portière-draped back. And then there are so many corners in a house, mantels and fire-places that make pretty vignette photographs. Not only

are such photographs of the greatest interest to the owner when made in his own home, but those of churches, theatres and famous buildings, and even of private dwellings, possess not a little architectural value.

The first requisite for making interiors is a good, perfectly rectilinear, wide-angle lens, and of as short a focus as will perfectly cover the plate used. A forward-focus camera is very convenient sometimes in photographing interiors, for often it is necessary to crowd well up into a corner in order to get a good field. Use always as quick a plate as can be obtained, for with the room properly lighted, and using a small diaphragm, so as to obtain the greatest of amount of detail possible, the exposure is long enough, even with the quickest plate, to satisfy the most obstinate advocate of slow emulsions.

The lighting is, perhaps, the cause of most failures. No direct sunlight must be admitted, but as much diffused light as possible, and the more the better. If possible, light the interior from the rear and sides; but if it is impossible to avoid a window in front of the lens, it must be carefully closed with its shutters and a curtain drawn over them. If this precaution is not taken, "halation" is sure to follow—"that appearance of halo—dark in the negative, light in the print—which makes its appearance around very bright objects in photographs," which Prof. Burton describes. When the sun shines directly through the rear or side windows, its light can be diffused by drawing the shades over the windows, if they be white; if not, white sheeting, or even paper, answers well. But an overcast day, if it be not too dark, is the best for photographing interiors.

Halation is also caused by light which is reflected from the back of the plate. The greater part of the transmitted light strikes the back of the plate. That traveling in a direction at right angles to or forming a large angle with the back of the glass, is transmitted through it; but those rays which strike the back of the glass at the angle of total reflection are sent back to the front surface, where they pass into the emulsion.

The means of avoiding the objectional appearance caused in this way is, of course, to back the plate with some substance

which absorbs light. Bitumen answers well for this purpose, also black carbon tissues moistened with glycerine. Plain paper of a dead black surface, cut into the proper size, does very well, and is easy to obtain and adjust.

By the use of paper films, instead of glass plates, for making interiors, one cause of halation is largely removed; but even with them an even and harmonious light is absolutely necessary in order to be perfectly free from this annoyance.

Do not strive after effects of chiaro-oscuro. We must depend on our arrangement and the development of the negative alone for artistic effect in the work. With a soft, even light over the entire room the best and only successful interiors can be made.

The exposure must be ample. An over-exposed plate on an interior can be treated with far greater chances for success than one which has been under-timed; indeed, an under-exposed negative had best be thrown into the waste-pile, and the developer, time and patience of the operator saved for less hopeless attempts. No definite time can be given as the correct one for an exposure on an interior, for so much depends on the amount and degree of light, which is ever changing. By experience one acquires the judgment which is necessary to decide the proper length of exposure, and the illumination on the ground-glass soon becomes a sure sign to the practiced eye.

Development, fixing and washing is proceeded with in the usual manner, and, if the exposure be correct, will be found to present no new difficulties. In this, as in everything else, "practice makes perfect," and by practice alone can we hope to attain perfection.

Inanimate Objects.

A variety of mercantile articles, such as machinery, inventors' models, etc., are often brought before the photographer. A few hints regarding the treatment of such objects may, therefore, also be mentioned in this Lesson.

Fabrics, Paper Hangings, Embroideries, etc.—If it is the object to photograph them for commercial purposes, they

should be stretched upon a plain board or screen, in order to present a plane surface. The nature of their colors invariably demands orthochromatic plates.

Laces should be placed similarly, but in order to show the delicacy of the structure they should be fastened upon a ground of sharply-contrasting color. White upon black, or *vice versa*.

Glassware.—Ornamented or cut plates are copied against a dark ground, to make the transparent parts appear black upon the photograph.

Hollow Glassware, Cut or Engraved, may be filled either with a colored opaque fluid, or, as in the case of globes or lamp-shades, be lined with dark muslin. They should receive such an illumination as to produce distinct lights and shadows, without which the photograph will not be plastic.

Porcelain or Delf should be similarly lighted. The objects being generally white and glossy, a proper exposure is important to obtain brilliant lights and fine shadows.

Bronzes.—On account of their non-actinic color and high gloss, lighting requires good judgment. To obtain the best general effect, a slight over-exposure is not only admissible but sometimes necessary.

Silver or Plated-ware.—Owing to their high polish these articles can be photographed only in very subdued light. To avoid inartistic reflections, the skylight or windows should be covered with a thin, white fabric or white tissue-paper, and side screens be used to subdue or control the light. In order to do away with the reflected image of camera and operator, often quite visible upon larger objects, a screen of neutral color should be placed immediately in front of the camera, allowing merely an aperture for the lens.

Machinery, when taken out of doors, is quite easy to manage, but much trouble occurs when the object is to be photographed in the shop, store, or warehouse, whose light is generally poor, and the distance from the position the camera can occupy perhaps insufficient. All available light should then be admitted, and as heavy machinery cannot be moved at the will of the operator, he should be provided with several lenses of different focal length.

Models.—The inventor directs from what point they are to be taken, and he knows exactly what he wants to show in the photograph. The United States Patent Office prescribes a particular size, 7x11 inches, with sufficient margin. Only this size is acceptable.

Plaster of Paris Cornices, Centre Pieces, Brackets, etc., must be fastened to a white ground and be placed in a light falling obliquely upon them, to secure distinct and transparent shadows and brilliant high lights.

Marble Statuary and Similar Works of Sculpture require illumination very much as portraits do, allowing, however, for their white color. The technical part offers no difficulties, but it is highly important to preserve a good balance between lights and shadows.

Furniture and Cabinet Articles.—The photographer is always inclined to place them in a perspective position, never quite satisfactory to the manufacturer, whose demands should be respected at least in this respect. The difficulty occurring here is to make the quality of the wood show distinctly as well as the upholstery and form.

Flowers and Leaves, when nicely arranged, make very interesting and beautiful photographs. As a correct representation of color values is one of the first conditions, we must invariably photograph them upon orthochromatic plates.

All these, and kindred objects, must be perfectly sharp; very small stops should, therefore, be employed when photographing them. Besides, they must be correctly exposed and carefully developed, for they are satisfactory only when free from blemishes.

LESSON XVI.

COPYING, ENLARGING AND REDUCING.

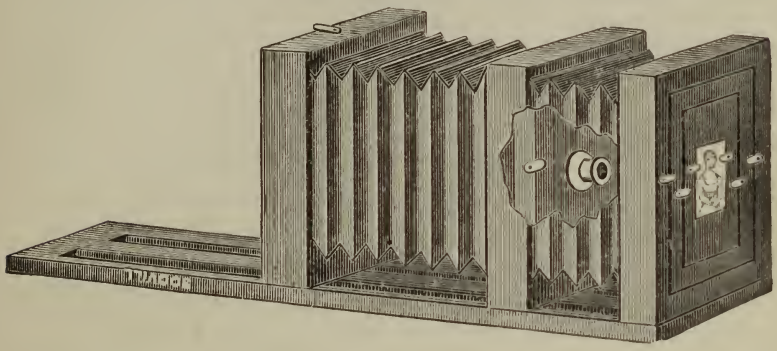
Photographers are almost daily called upon to copy not only photographs, but also paintings in oil or water colors, engravings, and the like. The mode of operating does not differ much from that heretofore described, but several important points must be observed, to which our attention has not yet been directed, and without which this work will give but little satisfaction.

Reproductions are made either in the natural size of the original, enlarged or reduced. In any case, the proportions of the original must be preserved. To do this the apparatus must be placed directly opposite the object to be photographed, and at right angles to it. Obliquity results in incorrect pictures, no matter how superior the lens may be. The object to be copied should receive a direct front light. If the work is to be done under the skylight, camera and object may be placed upon an elongated platform, movable upon a pivot with ball and socket arrangement, so as to place the original in a position oblique to the floor, but parallel with the skylight. If the object be very large, side-screens may be required to reflect light, or to subdue it before an uniform illumination can be attained.

We have seen, in practice, that the farther away the object is from the camera the smaller the picture will be, and, by reversing the axiom, we find that a very much enlarged picture can be made only by bringing the camera close to the object to be copied. The lesson, "Printing on Bromide Paper," speaks of enlargements; the principles laid down there may be adhered to in all other methods of enlarging. For portraits, when the central part of the picture—the head—is the main object, an ordinary portrait lens may be used; while landscapes, architec-

tural views, drawings or engravings, in which equal sharpness all over the picture is demanded, rectilinear lenses must be used, like the Morrison copying lenses, the Wale, "Universal," the Gundlach rectigraph, or the Steinheil aplanat.

A new apparatus, the Scovill Enlarging, Reducing and Copying Camera, is well adapted for the work. Its form of construction is made apparent by the illustration here given:



It is principally intended for the copying of negatives or glass positives; but by removing the kits in the front, the lens can be inserted into the same opening, rendering the apparatus capable of copying other objects as well. To copy a negative in the natural size, place it in the kit on the front of camera and button it in. Attached to the centre frame of the camera is a division upon which, on the side towards the camera front, a lens is mounted. Suppose this to be a quarter-plate portrait lens, the focal length of which we will suppose to be four inches; draw back the centre-frame and the lens to twice the focal length of the lens, slide the back-frame with ground-glass the same distance from the centre-frame. To enlarge with the same lens to eight times the size of the original, the centre of the lens must be four and one-half inches from the negative, and the ground-glass be thirty-six inches from the centre of the lens. To reduce in the same proportion, reverse and have thirty-six inches from the center of the negative, and from centre of lens to ground-glass four and one-half inches. These examples will furnish a key to the following:

TABLE FOR ENLARGEMENTS.

Taken from the "British Journal Almanac for 1882."

Focus of Lens.	Times of Enlargement and Reduction.							
In.	1 In.	2 In.	3 In.	4 In.	5 In.	6 In.	7 In.	8 In.
2	4 4	6 3	8 $2\frac{3}{4}$	10 $2\frac{1}{2}$	12 $2\frac{2}{5}$	14 $2\frac{1}{3}$	16 $2\frac{2}{7}$	18 $2\frac{1}{4}$
$2\frac{1}{2}$	5 5	$7\frac{1}{2}$ $3\frac{3}{4}$	10 $3\frac{1}{3}$	$12\frac{1}{2}$ $3\frac{1}{8}$	15 3	$17\frac{1}{2}$ $2\frac{11}{12}$	20 $2\frac{6}{7}$	$22\frac{1}{2}$ $2\frac{13}{16}$
3	6 6	9 $4\frac{1}{2}$	12 4	15 $3\frac{3}{4}$	18 $3\frac{3}{5}$	21 $3\frac{1}{2}$	24 $3\frac{3}{7}$	27 $3\frac{3}{8}$
$3\frac{1}{2}$	7 7	$10\frac{1}{2}$ $5\frac{1}{4}$	14 $4\frac{2}{3}$	$17\frac{1}{2}$ $4\frac{3}{4}$	21 $4\frac{1}{5}$	$24\frac{1}{2}$ $4\frac{1}{12}$	28 4	$31\frac{1}{2}$ $3\frac{15}{16}$
4	8 8	12 6	16 $5\frac{1}{4}$	20 5	24 $4\frac{4}{5}$	28 $4\frac{2}{3}$	32 $4\frac{4}{7}$	36 $4\frac{1}{2}$
$4\frac{1}{2}$	9 9	$13\frac{1}{2}$ $6\frac{3}{4}$	18 6	$22\frac{1}{2}$ $5\frac{5}{8}$	27 $5\frac{2}{5}$	$31\frac{1}{2}$ $5\frac{1}{4}$	36 $5\frac{1}{7}$	$40\frac{1}{2}$ $5\frac{1}{16}$
5	10 10	15 $7\frac{1}{2}$	20 $6\frac{2}{3}$	25 $6\frac{1}{4}$	30 6	35 $5\frac{5}{6}$	40 $5\frac{5}{7}$	45 $5\frac{5}{8}$
$5\frac{1}{2}$	11 11	$16\frac{1}{2}$ $8\frac{1}{4}$	22 $7\frac{1}{3}$	$27\frac{1}{2}$ $6\frac{7}{8}$	33 $6\frac{1}{2}$	$38\frac{1}{2}$ $6\frac{5}{12}$	44 $6\frac{2}{7}$	$49\frac{1}{2}$ $6\frac{3}{16}$
6	12 12	18 9	24 8	30 $7\frac{1}{2}$	36 $7\frac{1}{6}$	42 7	48 $6\frac{6}{7}$	54 $6\frac{3}{4}$
7	14 14	21 $10\frac{1}{2}$	28 $9\frac{1}{3}$	35 $8\frac{3}{4}$	42 $8\frac{2}{5}$	49 $8\frac{1}{6}$	56 8	63 $7\frac{7}{8}$
8	16 16	24 12	32 $10\frac{2}{3}$	40 10	48 $9\frac{3}{5}$	56 $9\frac{1}{3}$	64 $9\frac{1}{7}$	72 9
9	18 18	27 $13\frac{1}{2}$	36 12	45 $11\frac{1}{4}$	54 $10\frac{4}{5}$	63 $10\frac{1}{2}$	72 $10\frac{2}{7}$	81 $10\frac{1}{8}$

It is assumed that the photographer knows exactly what the focus of his lens is, and that he is able to measure accurately from its optical centre. The use of the table will be seen from the following illustration: A photographer has a *carte* to enlarge to four times its size, and the lens he intends employing is one of six inches equivalent focus. He must, therefore, look for 4 on the upper horizontal line, and for 6 in the first vertical column, and carry his eye to where these two join, which will

be at 30—7½. The greater of these is the distance the sensitive plate must be from the centre of the lens; and the lesser, the distance of the picture to be copied. To *reduce* a picture any given number of times the same method must be followed, but in this case the greater number will represent the distance between the lens and the picture to be copied; the latter, that between the lens and the sensitive plate. This explanation will be sufficient for every case of enlargement or reduction.

If the focus of the lens be twelve inches, as this number is not in the column of focal lengths, look out for 6 in this column and multiply by 2; and so on with any other numbers.

Reproductions require proportionally much longer time of exposure than portraits or landscapes, and in this particular point frequent errors are made, generally towards over-exposures. The operator must learn by practice how much time to give, probably with the loss of a few plates, before the required experience can be attained.

As with the full aperture of the lens, enlarged pictures will appear upon the ground-glass with a want of definition, small stops become necessary to retain the original sharpness.

Oil paintings demand almost invariably a direct front illumination. If, from the glossy varnish, reflections occur, they must be counteracted by a dark side screen; naturally with loss of much light. Aquarelles or pastelles appearing brighter are easier to copy.

Daguerreotypes or pictures under glass must, on account of their reflecting properties, be placed so that reflections of light are overcome. Daguerreotypes often show buff marks upon polishing the metallic plate. It is better to copy them by direct or reflected sunlight. Photographs when highly burnished or enamelled receive the same treatment as other pictures with glossy surfaces. Ordinary photographs generally copy very well, with the exception, perhaps, of those very much enlarged, when the grain of the paper shows rather too strongly.

Plates may be developed as described in Lesson V, or with any of the standard formulæ for developers.

For line work, when a negative in black and white only is desirable, and when no half tones or modulations are to be pre-

served, we resort to the ferrous oxalate developer described in the Lesson on "Printing on Permanent Bromide Paper." For that class of work, time of exposure is even more important than for ordinary copying, as by a probable reinforcing, or long-continued developing, the sharpness of lines is often considerably damaged, making the negative utterly worthless if a relief plate is to be made from it. Referring to the formula described before, we take three ounces of the solution of oxalate of potash and add to it one ounce of the solution of sulphate of iron. If more iron is used, the mixed solution will turn turbid and separate a yellow precipitate; in such a state it should not be used. The perfectly clear and transparent red solution is poured over the plate, and the appearance of the image closely watched. If the image comes with anything like rapidity, pour the developer off, wash slightly, and flood the plate with a solution of pure oxalate for a minute or two, pour off, and without washing, continue with the original developer. If the effects of over-exposure are still apparent, restrain with

Iodine	15 grains
Alcohol	3¼ ounces

to which, after being dissolved, add three and a quarter ounces of water.

From fifteen to twenty drops of this compound added to the developer will secure the intensity and clearness of the lines desirable in black and white negatives.

Whenever legal documents, autographs, commercial papers, etc., are to be reproduced, this method will prove to be perfectly reliable.

LESSON XVII.

ORTHOCHROMATIC, OR COLOR-SENSITIVE PHOTOGRAPHY.

When we subject a photograph to critical examination, and compare the effects which colors have produced upon our plate, with their appearance of brightness or value of tone in the original, we find that our reproduction is very far from a correct representation of what the eye has seen. While form, light and shade have been photographed in perfect correspondence with the original, colors have not been so reproduced. Our plates copy the bright yellowish-green of vernal foliage quite dark, and the far-distant blue mountains in a landscape so extremely light, that most careful development is not capable of rendering them harmoniously with the general aspect of the scene. The bright scarlet blossom of the geranium copies like the green leaves of the plant; the crimson tulips, seamed with yellow, show no color contrast; and the dark blue hyacinth appears nearly white in the ordinary photograph.

The cause of this untruthfulness in photography was well understood by the earliest experimenters, they knowing very well why different effects could not be expected.

All light does not act upon a photographic surface, but only certain parts of light.

The force or power that causes photographic, or photo-chemical action, scientists have called *actinism;* and the active rays, *actinic.*

Actinic rays are those found at one end of the spectrum, the violet and blue, called most refrangible by spectrum analysts. Red, orange and yellow, at the other end of the spectrum, do not act at all, or but very feebly. The latter rays do not deviate so much from the path of undivided light, as blue and violet do, and are, therefore, called less refrangible.

If we expose an ordinary photographic plate at the solar spectrum, these effects will show to perfection how differently the two ends of the spectrum work. Violet and blue will give very pronounced impressions, but they will diminish more and more, until, at the other end of the spectrum, no effect is visible.

This is exactly what we notice in every-day photographs. Yellow and orange copy much too dark; some reds do not impress the plate at all; and blue and violet, no matter how dark they may be, invariably come too light; and the variety of colors in fabrics, embroideries, paintings, and many natural objects have thus given endless dissatisfaction to the photographer.

For many years it was considered as impossible to remedy these defects, as we now think it impossible to photograph colors themselves.

With orthochromatic or color-sensitive plates we overcome these difficulties, and produce effects nearly correct in their value of brightness.

An immense amount of practical work and labor had to be done, before anything worthy of interest was attained, but we cannot deny that the discovery of the process is based absolutely upon theories, and has been established by experiments in spectroscopy. These experiments were based again upon one principle, that is, the addition of some substances, possessing the power of absorbing and converting into chemical energy those rays which upon an ordinary plate have no effect.

For this purpose, a large number of dye-stuffs were found to be most effective. They are themselves sensitive to light, for they bleach when exposed to it. Bleaching action was found to be strongest on the red end of the spectrum, which has no effect on ordinary plates. The most generally adopted theory for this is, that the energy absorbed in bleaching the dye is transmitted to the silver haloid of the plate, overcoming its passiveness and rendering it capable of development.

Of the many dyes that have been experimented with, only a few have been retained although many more are being added, according to the researches constantly made. It is true, not

all of these dyes sensitize alike, or for several colors at the same time, and as the spectrum photographer proposes to examine distinct spectrum-regions with distinct media, the practical photographer selects colors that give the best general effect.

Some of the dyes, known by the name of eosines, answer admirably, though many of them do not, and all of them refuse to reproduce red beyond a certain point. A very happy combination of dyes, belonging to another class, has been made, which cause sensitiveness far into the regions of the spectrum red. This action is due to one of its ingredients, cyanine, or chinoline blue, the most red sensitive substance known.

To obtain the best general effects in pigment colors, we employ another dye, the erythrosine, which is also an eosine. With it the best practical results can be obtained, for it sensitizes to perfection up to orange, yellow and green, giving, at times, quite correct reproductions even of red, when that color is not perfectly pure but partly mixed with other colors. And we find but rarely pure red in pictures, fabrics or embroideries, hence erythrosine has been selected pre-eminently as the sensitizer for commercial plates and every-day work.

Occasionally, cyanine, in small portions, is added to the erythrosine to obtain better red-sensitiveness, and it acts then very satisfactory in that combination.

Violets and blues will, even with these plates, exercise a very violent action, and, to suppress it, a ray filter, principally of a pure yellow color, is employed, it being placed between the lens and the sensitive plate.

At first, the dye itself was incorporated with the emulsion, and with that the plates were coated. Practical work, and Mr. Plener, with his centrifugal machine, showed that but an extremely small quantity of color was requisite to give effects. In fact, after an emulsion had been colored, he separated from it the bromide of silver, re-emulsified it, and, with the infinitesimal amount of color combined with the silver, obtained the same effects. All this led to the redemption of an almost-forgotten process, the staining of ready-coated plates to color-sensitize them.

This way of working has become more popular than any other method, and although color-sensitive plates, colored in the emulsion, have become an article of commerce, stained, or bathed plates, as they are commonly termed, seem to be preferred by most operators.

For general work erythrosine has been found to be the most effective, and a preparation known as Flandreau's S. P. C. Orthochromatic Solution carries it as chief ingredient.

With this solution any photographer may make his own orthochromatic plates, and any good plate may successfully be rendered orthochromatic by simply bathing it with the erythrosine solution.

When orthochromatic plates are used for reproductions of landscape work, it is advisable to color-sensitize plates of only moderate rapidity. The Carbutt "B" and the Cramer, of lower grade, answer very well for this purpose, while for shorter exposures the "Eclipse" is better adapted.

The formulæ are as follows:

PRELIMINARY BATH.

Aqua ammonia	1 dram
Water	7 ounces

COLOR BATH.

Erythrosine	1½ drams
Aqua ammonia	2 drams
Water (distilled)	5½ ounces

and the directions are simple.

Immerse a plate of medium sensitiveness in the preliminary bath and allow it to remain therein for three minutes. After removal, drain well, and, without washing, plunge the plate in the coloring-bath, rocking it gently to secure uniform contact with the solution. The plate should not remain in the color-bath longer than seventy-five seconds, as a long-continued exposure to the color-solution will depress the general sensitiveness without increasing that for colors. If a large number of plates are prepared with the same solution it is advisable to add, after the eighth or tenth plate, about ten to twenty drops of the erythrosine solution. The colored plates must be well drained, reared upon blotting-paper, and dried in the ordinary closet.

Colored plates may be exposed while still wet, and the general sensitiveness is somewhat decreased thereby. If, however, the object to be photographed requires a very long exposure, it is better to use a dried plate.

The development of erythrosine plates offers no serious difficulties; but it must be remembered that the plates, being so sensitive to color, especially to yellow, the process must be carried on either in the shadow of a subdued ruby lantern, or in a light obscured by several thicknesses of brown tissue paper.

To suppress the violent action of blue and violet, a yellow screen is placed between the sensitive surface and the objective; the best method being to fasten the screen on the back of the front bearing the lens. It being difficult to obtain glass of pure yellow color, photographers prepare these screens themselves by coating a very thin and white plane parallel glass with xanthine collodion.

The yellow color imparted to the collodion is sensitive to light, and plates prepared with it will fade when exposed unnecessarily for a long time.

With the interposition of the yellow screen (which is absolutely necessary for the copying of objects in which blue and violet predominates), the time of exposure must be increased from three to six times that of an ordinary plate.

With artificial light of sufficient force the yellow screen can be dispensed with; a yellow cylinder-globe or shade placed over the source of light answering equally well.

The yellow glass should be very thin; if unnecessarily thick, the time of exposure becomes longer. Focus should be taken with it, as a refraction of light may occur, making a perceptible difference.

The reproduction of oil paintings, aquarells, fabrics and other articles colored highly in various shades, does not require any particular precautions. When much red is present, the exposure should be lengthened; with the absence of blue, the yellow screen may be dispensed with, neither is it required for general landscape work. Artificial light, rich in yellow and orange light, allows work without the screen.

As a formula for developing, which gives very good results, we may adopt:

1.—Granulated sulphite of soda	3 ounces
Water	1 quart

In this solution dissolve:

2.—Pyrogallic acid	½ ounce
Granulated carb. of soda	2 ounces
Water	1 quart

For normal exposure add 1 ounce of water to 1 ounce of each No. 1 and No. 2.

All orthochromatic plates should receive a full exposure; but if too much time has been given, restrain with bromide of potassium, not with bromide of ammonium.

Development had better be commenced in total darkness. After the expiration of two minutes, when the color-stuff has been partly washed away, the plate may be examined in a weak red light, and the process may therein be continued. Fixing, washing, intensifying or reducing is accomplished in the same way as with ordinary plates. With some emulsions the color is difficult to wash off the plate; when this is the case, a little alcohol will remove it more effectually than water.

LESSON XVIII.

TRANSPARENCIES, AND HOW TO MAKE THEM.

There are various methods and processes for making transparencies, many of which have passed into history, and, as the object of this lesson is to place before the reader the latest method, combining simplicity of manipulation with perfection of result, it will be only necessary to enumerate the various methods of the past, without entering into a detailed description of them. They comprise the albumen; collodio-albumen; collodio-bromide; bathed dry-plate, in which a bromo-iodized collodion plate is sensitized in a solution of silver nitrate, and, after being washed, is coated with a preservative; collodio-chloride, wet collodion process, which is still used by professional slide-makers; carbon, and the Woodbury processes.

At the present time two processes only are in use in America, viz.: the old wet collodion process and the new gelatine dry-plate process. The first is limited in its use to those who make lantern-slides mainly for advertising purposes, while the new gelatine dry-plate, of the special kind made for producing transparencies known as Carbutt's gelatino-albumen plate, is almost universally used by amateurs and the professional portrait and landscape photographer. It is in the use of these plates, therefore, that we shall proceed to describe the necessary operations.

The requisites for contact printing are a deep printing-frame a size larger than the negative to be used, with a flat, glass bottom free from scratches (crystal plate is best); some thin red enameled label paper for masks, a Carbutt "Multum in Parvo" lantern or other artificial light, and transparency plates of the suitable size. Those for lantern-slides are made on thin crystal glass of the now accepted standard size, $3\frac{1}{4}$ by 4 inches;

for the larger size transparencies they are made on fine ground-glass, which has the advantage over the clear glass, that the image is rendered in its right position when made by contact with the negative, just as a silver print would be, the obscured side of the glass being back of the image, and it only remaining to cover it with a clear glass and mount in a suitable sized metal frame which is sold for that purpose. The transparency need not be confined to the size of the negative; the image can be enlarged or reduced to suit the taste and circumstances; nor is it absolutely necessary, for the purpose of enlarging or reducing the image, that a camera be provided, if the use of a small room can be commanded, and the light shut out from all but one part of the lower sash. Over this light must be placed, and covering the entire surface, a sheet of fine ground-glass, which will give an evenly diffused light to pass through the negative; beneath this a support for the negative should be placed. The same camera and lens used in making the negative can be employed for making the transparency, provided the image is to be reduced in size, and the negative can be held upright in one of the plate-holders. The camera itself may be supported on a board raised to such a height that the lens will center with the center of the negative. Care should be taken, in adjusting it, that the side of the camera and the face of the plate-holder holding the negative forms a perfect right angle. If it is desirable to make an enlarged transparency, say from a 4x5 or a 5x8 negative to an 8x10 plate, the same camera and lens must be used, but the ground-glass of the camera must be removed, so that the magnified image may pass through the camera into the sensitive plate, supported in an upright position at the distance found to be correct. To ascertain this the camera with its lens should slide easily between two strips, for, unless your camera is provided with a front rack movement, you will have to move the camera, and with it the lens, to obtain a focus, using a light of glass on which is stretched a piece of white paper to obtain a focus, and placed against a support on the board carrying the camera, and at right angle with the base of it. This is supposing you are working in a room in which all light, except

that passing through the negative, is excluded before placing the negative in the holder or support. If it is desirable to have a margin on the transparency, cut out a mask from the thin, red enamelled paper or tin-foil, and place on the face of the negative, being careful to see that the margin shows equally around the large plate or focusing screen.

While the foregoing description will enable any one to produce enlarged or reduced transparencies from their negatives, it is but a makeshift, and will be found to entail great loss of time and uncertainty in working, which can be avoided by using a properly-constructed camera, such as that made by the Scovill Manufacturing Co.* The writer of this article has had one in use for years. The end holding the negative has adjustments for centering the image, and the extended range of adjustment of the lens enables a lantern transparency to be made from an 8x10 negative, or vice versa; an 8x10 transparency from a $3\frac{1}{4}$x$4\frac{1}{4}$, or other intermediate sized negative.

Having explained the tools required, let us now proceed with our description of the chemicals required and the making of the proper solutions.

Of chemicals will be required the following:

Neutral oxalate of potash	1 pound
Sulphate of iron	1 pound
Hyposulphite of soda	5 pounds
Alum	1 pound
Citric acid	¼ pound
Liquor ammonia	4 ounces
Plain collodion varnish	8 ounces

Too much stress cannot be laid on the procuring of chemicals of the greatest purity; especially is it necessary that the first two articles named should be pure. Many have been disappointed in their efforts at transparency-making by applying to the country druggist for oxalate of potash and have been supplied with bin-oxalate of potash; be careful, therefore, to procure the chemicals from a reliable dealer in photographic materials. In compounding the solutions, first prepare, by a thorough cleansing, suitable sized bottles; for the bulky solu-

* Described minutely in Lesson XIV.

tions, nothing is better than the ordinary glass preserve jar; and for labels, a safe plan is to cut from the circular accompanying the plates you are to use the formulæ, and paste them on the glass jar to contain the solution it describes. Next in importance is the water; clear, soft river or spring water, melted ice or distilled water, as is most convenient, should be used, but never hard water containing lime in solution.

We shall now describe a very excellent plan that has been used for years in dissolving large crystals—a method that does away with the use of a pestle and mortar. After filtering the A solution of following formula, select a one-half gallon glass preserve jar; and for B solution, a quart jar. Measure into each one the quantity of water required, except that in the B solution a few ounces of the water may be reserved until after solution of the iron salt. To dissolve the salts, so as to need no after-filtering, take a common domestic salt bag, washed to free from salt, and in this place the crystals and suspend it in the water so that the bulk of the salt is just covered by the water; immediately a stream of denser liquid will be seen falling to the bottom of the jar; this will continue until the whole of the salts are dissolved and a clear solution is the result; then remove the bag, give the bottle or jar a shake, and the solution is ready. The same method is to be employed in dissolving the iron and hyposulphite of soda, using a separate bag for each one, and completing one before commencing the other. Having everything ready, carefully weigh out by avoirdupois weight the chemicals, and make solutions as per following formula:

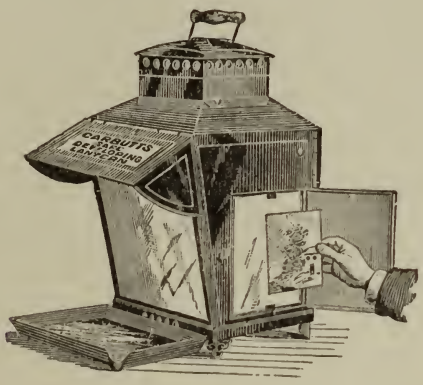
CARBUTT'S IMPROVED DEVELOPER FOR TRANSPARENCIES.

a.	Oxalate of potash	8 ounces
	Water	30 ounces
	Citric acid	60 grains
	Citrate of ammonia solution	2 ounces
b.	Sulphate of iron	4 ounces
	Water	32 ounces
	Sulphuric acid	8 drops

c. *Citrate of Ammonia Solution.*—Dissolve 1 ounce citric acid in 5 ounces distilled water, add liquor ammonia until a slip of litmus paper just loses the red color, then add water to make the whole measure 8 ounces.

Developer.—Add 1 ounce of B to 2 of A, and ½ ounce water and 3 to 6 drops bromide solution.

In the making of transparencies, the first requisite is a good negative, and every effort and care should be taken when producing it, to insure its freedom from imperfections; the second requisite is a suitable artificial light for use when making exposures by contact, and we know of none better than Carbutt's "Multum in Parvo" Lantern, designed especially for



this class of work. It has a safe light in front, to be used when developing negatives or transparencies; two side doors, that to the left when opened emitting clear, white light; and a reflector attached to the revolving lamp, which throws parallel rays towards the printing-frame holding the negative and sensitive plate. The door on the right, when opened, reveals a light of opal glass, through which the soft white light allows the negative or positive to be examined. The third requisite is suitable sized developing dishes, and these should be of porcelain or the enameled iron ware, and cannot be used with the pyro developer without risk of staining the transparencies, as we use for them the ferrous-oxalate developer only. Having now provided ourselves with the necessary requisites for the work, we can proceed with the making of transparencies, beginning with the popular lantern-slide. For convenience of exposing the plate, the lantern should be hung in front of the operator so that the bottom is about twelve inches from

the work-bench. To the left, and in line with the bottom of lantern, should be fixed a bracket-shelf, so that the printing-frame can be supported at a distance of about twenty inches from the lamp-flame. We now place our negative glass in contact with the glass in a deep printing-frame; a suitable size is 6½x8½, for that answers for 5x8 and under; over this place one of Carbutt's thin, crystal, transparency plates, so as to cover the portion of the negative desired; lay a piece of dark felt or other soft material over it; close down the back; turn the lamp of the lantern by the knob underneath, so that the reflector faces to the left door of the lantern; and allow the clear light to act from ten to fifteen seconds; close the door of the lantern; remove the plate from the printing-frame; place in a 4¼x5½ porcelain dish, and flow over sufficient of the developer to well cover the plate. If correctly timed, the image should appear slowly, taking two or three minutes to complete; allow the development to continue, however, until the blacks look quite strong, and detail is plainly showing in the high lights; then wash off the developer, and immerse in a fresh solution of the hyposulphite of soda (pyro-developed negatives should not be fixed in the same solution), made by dissolving 8 ounces of the salt in 40 ounces of water, in the same manner as directed for dissolving the iron salt. Let the transparency remain in the fixing-bath three to five minutes after the white bromide seems cleared from the plate; wash for half an hour in running water; then immerse for five minutes in the

HARDENING SOLUTION.

Water	36 ounces
Pulverized alum	3 ounces
Citric acid	¼ ounce

Afterwards wash again, and this time for twenty minutes to half an hour; then carefully go over the surface with a tuft of absorbent cotton, while water is running over it, give a final rinse, and place in a drying-rack to dry spontaneously. Finally, varnish with plain

COLLODION VARNISH.

Alcohol	4 ounces
Pyroxaline	30 to 40 grains
Sulphuric ether	4 ounces

When, after shaking, the cotton is dissolved, filter and flow the plain collodion over the dry transparency; then dry, cover with matt and a crystal cover glass, and bind with black binding strips.

Transparencies for window and door decoration should be made on plates somewhat larger than the negative, so that a suitable margin may surround the image. To do this, cut a mask with rectangular or other opening out of the thin red enamelled paper. For an 8x10 transparency from a $6\frac{1}{2}$x$8\frac{1}{2}$ negative, take a piece of the mask paper 9x11 with two sides cut to right angles; make a line with pencil and ruler $1\frac{1}{4}$ inches from two sides; from the side line measure $5\frac{1}{4}$ inches, and from the cross line measure $7\frac{1}{4}$ inches; cut on these lines with a sharp knife through the paper laid on glass or zinc, and remove the blank; make a x mark on left upper corner, to denote register corner, place this mask in a 10x12 deep printing-frame; let it register close to the left-hand upper corner, lay the negative film side up and under the mask; adjust the negative so as to show in proper position through the opening; over this place a Carbutt A transparency plate 8x10, letting it register in the same corner as the mask; lay over a pad of black Canton flannel or felt; close the printing-frame; expose to the lamp or gaslight ten to fifteen seconds or more, according to degree of density of negative. Develop as directed for lantern-slides, and in every other respect proceed the same.

The tone, both of lantern and large transparencies, can be varied from a warm brown to a velvety black. Increased exposure and weaker developer (adding water) with more bromide gives warm brown tones. Short exposure and stronger (undiluted) developer gives dark tones.

LESSON XIX.

LANDSCAPE PHOTOGRAPHY.

It has been said by those engaged in the instruction of youth, that they often find it far more difficult to eradicate from the mind of a pupil the errors of previous training, than to impart and render permanent such knowledge as is required. A false start on the road to knowledge may soon lead to discouragement, and, finally, to overwhelming disaster. And this is just as likely to occur with older as well as with young students in the technical science and art of photography. Few, if any, students, in any department of art have attained a prominent position in his or her profession without beginning with the rudiments and thoroughly mastering the first principles.

First lessons may seem uninteresting, and, to many appear unnecessary—a waste of time and material. But, if neglected, it is *more* than probable that far *more* time and greater expense will be demanded for correction of the mistake, besides the worry and regret which is sure to come with the conviction that the beginning has been too hurried and its details too lightly passed over. Do not expect to at once produce results equal to those of workers who have grown gray in the same field of labor, and if you do have such expectations, do not be discouraged by a few failures.

It is well to begin with a fixed determination that *quality* should be the first and most important, and *quantity* a secondary or unthought-of factor. A good picture of a single tree, shrub or even leaf, a small picture of a corner in the garden, a field or bit of water, is far more satisfactory, instructive and valuable than a so-called *fair* picture, however broad the space shown may be. Do not try to photograph everything you see; select your subject after consideration, execute your

work with deliberate care, and you may afterward take pleasure in exhibiting the results to your friends.

First secure good apparatus. Do not define the word good as here used to necessarily mean high priced ; very fine work is often done with comparatively cheap tools. Safety of expenditure is best secured by intrusting orders to a well-known and reliable firm. Otherwise, purchases of apparatus should be made under the counsel or by the advice of some competent person, who has been made acquainted with the requirements and conditions of the buyer. Good, *cheap* apparatus may be found if properly sought for. But a great deal of apparatus is sold which is dear at *any* price, having less real value than the raw material from which it has been constructed.

After determining to procure an outfit, begin study for its use. Select subjects and study them from various points of view, and under different lights of morning, noon, or later in the day. Observe the effect under various conditions of illumination. Some of the finest photographs of American landscapes have been made under an obscured or partially clouded sky just before the morning sun appeared above the horizon. The light reflected from such a sky is soft and yet brilliant, while the air usually has less motion than at any other time of day, and the dewy sparkle of the foliage is found only in the early hours of the day.

In the broad expanse of field and detached woodland, the brighter light of later hours is often most desirable on account of the well-defined shadows which serve to break up the monotony and give brilliancy to such scenes. A herd of cattle, or a flock of sheep—which add much to the beauty of landscape pictures—are less likely to be in motion, and are oftener found in picturesque groups in the early morning. No landscape of any considerable breadth should be photographed without the introduction of animals or familiar figures.

If animal life is represented in the picture, do not place it in the immediate foreground, unless it is to appear the important feature of the scene. Whether the figures used are biped or quadruped, they should be placed at such a distance as will prevent their blocking out other important objects, or giving the appearance of crowding.

Many beautiful landscape pictures may be secured in the late afternoon hours, even up to within a short time of the sun's disappearance below the horizon. This is an especially favorable time of day for fine cloud effects. In scenes made up of large masses of foliage, it will be found necessary to give considerably longer exposure. This increase of exposure is very important in heavily wooded, mountainous districts. The absorption of actinic force and the low power of the reflected green rays are such that considerable care is necessary for producing fine work under such conditions.

Care should be exercised in setting up the camera for field work. In most instances it is necessary to have the camera horizontal and level, and any desired change in the boundaries of the picture may be made by a proper use of the sliding front or swinging back of the instrument. For more or less sky or foreground, lower or elevate the sliding front or lens board of the box, and, for side changes, utilize the wide swing-back. This last-named motion is very important when a long stretch of shore, river or street view is under treatment. By swinging the end of the ground-glass focusing screen, showing the near objects back or further from the lens, and the end showing the distant objects nearer to the lens, much finer rendering of details is secured.

When the body of the camera is much tipped up or down, the result is likely to be greatly distorted and give a false character to the picture. It is seldom advisable to photograph landscape scenes from the shadow side. The shadow, unrelieved by illuminated portions, produces a sombre effect in the work.

The proper rendering of distant views is best secured in clear, bright weather. Even a slight veil of fog or smoke is quite sufficient to prevent good results, under otherwise most favorable conditions. By clear weather, a cloudless sky is not necessarily meant, but rather such conditions as show the air to be free from smoke or fog, which give to distant objects a dim or hazy appearance. A sky partially obscured by thin, light, fleecy clouds, reflects an excellent light for fine landscape work. The pleasant weather immediately after a heavy rain is also very favorable. At such times the floating particles

have been precipitated or washed from the air, and the dust with which foliage has become coated in dry weather no longer absorbs the light, or prevents reflection from smooth surfaces.

When photographing a scene including any considerable expanse of water, choose some point of view from which the surface of the water does not present a broad, brilliant sheet of unbroken white. This is sometimes difficult if there is neither a fresh breeze nor a flowing current; and if either of these conditions exist, the picture is apt to be unsatisfactory unless made by instantaneous exposure, and such short exposures often result in hard or inharmonious prints, when considerable expanse of woodland or heavy foliage is included.

A field of waving grain, or the long, majestic swing of tall forest trees in a heavy gale of wind, are beautiful objects to look upon, but are as yet beyond the reach of photographic illustration, because the light at such times is usually too weak for the rapid exposure required for satisfactory results with moving objects.

Beginners, and in fact old workers, are apt to commit errors in time of exposures in the open air. This is not mainly due from lack of ability to judge of the amount of illumination, but rather from disregard of the color of the light. During long periods of dry weather the air becomes filled with particles of floating matter, which gives the light a yellow, non-actinic tone, requiring much longer exposures in the camera.

It is advisable to keep full notes of all work done in the field, as such records often prove valuable in after-work of the same class. Field books for such records may be had from most dealers in photographic materials. Plate-makers and chemical manufacturers are many times blamed for faulty results which are due to lack of judgment, or its proper exercise when the materials are used.

Great care should be taken to prevent light from reaching the inside of the plate-holder or camera box, except such as passes through the lens, when the exposure is made. It should be remembered that the light under an open sky is much stronger than it is inside a room, and a small leak which

would be scarcely noticeable in the latter, may be, in the former, sufficient to illuminate the entire inside of the camera-box or plate-holder. A cloth or opaque cover is advisable for shading the camera during exposure in the field. Some have recommended enveloping the entire camera-box in a shield of some light opaque material, made up in the form of a bag sufficiently large to admit of drawing and replacing the slide without removing or opening the bag.

Every record of field work should state the focus of the lens used and the exact diameter of the stop or diaphragm. To state that you used for certain results Mr. S——'s lens with No. 3 stop, really conveys no information to the listener, unless he is familiar with the lens. But when you say I used Mr. S——'s eight-inch focus lens with one-half-inch diaphragm, your listener can at once understand the conditions under which the picture described was made.

The development of a landscape plate should, theoretically, not be different from that of other work, but when we consider the variety of influences bearing upon the work, among which are principally the varying conditions of light, it will readily be understood that a different procedure must be adopted.

It may be taken, as a rule, that for timed landscape work no better plate can be found in the American market than our favorite, the Carbutt B, with which we have become familiar, and the fine qualities of which we have had ample opportunity to observe. Time of exposure depends, in landscape photography, as well as in every other branch of the art, upon the degree of sensitiveness of the plate, the quality of light, the time of day, and the color of the object. Thus, for instance, will dark-green, wooded scenery require a much longer time than a view on the lake shore or ocean beach; a white marble palace or a white frame cottage much less than a brick or brown-stone-front house.

The results of the practicing class, 1886 and '87, of the C. S. P., encourage us to continue, for that class of work, with the Chautauqua developer, composed as follows:

A. Bromide of ammonium..... 2 drams
Water..... 8 ounces.

B. Aqua ammonia..... 1 ounce
Water..... 7 ounces.

C. Pyrogallic acid..... 1 dram
Water..... 12 ounces
Nitric acid..... 5 minims.

For properly-timed exposures take of

A.....40 minims
B.....20 minims
C.....½ ounce
Water..... 2 ounces.

For over-exposures restrain the action by adding to each ounce of the mixed developer from three to five minims of *A*, and for under-exposures accelerated with a few drops of *B*, being careful not to use it excessively, for then green fog will invariably result.

For instantaneous exposures, when but rarely the proper time can be approximately estimated, the mode of operating requires modification.

We return here to the original developer, as described in Lesson V.

When, on account of weak light, or extremely rapid speed of the shutter, under-exposure may reasonably be suspected, a good method is to bathe the plate in a diluted alkali solution before proceeding with the development.

The alkali solution, No. 2, of Lesson V, may be mixed with three volumes of water. After the plate has soaked in this for two or three minutes, it is removed, washed and placed in diluted developer of the normal composition. The strength of the developer may be increased as the process goes on, until a proper amount of density and detail is obtained.

For instantaneous work, the following formula has found much favor among the students of the corresponding class:

a.	Water	12	ounces
	Pyrogallol	1	ounce
	Gran. sulphite of soda	2	ounces
	Bromide potassium	80	grains
	Citric acid	60	grains
b.	Water	12	ounces
	Gran. sulphite of soda	2	ounces
	Carbonate of potash	3	ounces

To make the developer, take 3 drams of each *a* and *b* to 4 ounces of water.

In our opinion, the finest results can be effected by merely modifying the developer. When a plate shows signs of under-exposure, the normal developer must be at once removed and a quantity of pure water poured into the tray, in which the plate remains while the operator is mixing a new developer to suit the peculiar case.

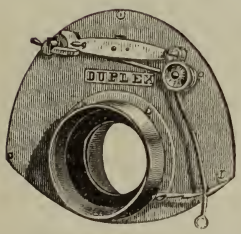
All authorities, and the most successful practitioners advise the employment of a weak developer, in cases of under-exposure, at the commencement of the operation. Often it becomes necessary to change the developer several times in the course of one development, each solution being prepared to suit the exact state of the plate in which the previous one left it. Old developers—that is, those which have been used once or twice—are very serviceable for starting the action on an over-timed plate.

As the process progresses, it will be seen what treatment is necessary, and a fresh developer, which is rather weak in alkali, perhaps, will be used in place of the old one. A weak developer, if used to the end, will yield but a feeble negative; it must be strengthened as the development continues. Of course, it requires a much longer time to complete development when a weak developer is employed and the process is stopped, from time to time, to prepare new and slightly stronger solutions; but the result is reasonably sure. With the proper amount of time and patience, a fair printing-negative can be produced by this method of procedure from a plate that was apparently over-exposed.

Never force an under-timed negative by increasing the amount of alkali in the developer; it can only result in failure. A developer which is very strong in soda or potash frequently causes a plate to frill, besides yielding a hard and glassy negative. If too much ammonia is used, the result is green fog. Forcing an under-timed plate invariably results in a foggy negative. The temperature, too, is an important condition to be observed when preparing a developer. In summer and warm weather considerably less alkali is needed than in colder weather.

The drop-shutter—which is an indispensable instrument for instantaneous exposures—explains itself by the simple mode of construction and easy way of attachment as shown in the cut.

A more complicated arrangement is found in the Prosch "Duplex."



PROSCH DUPLEX.

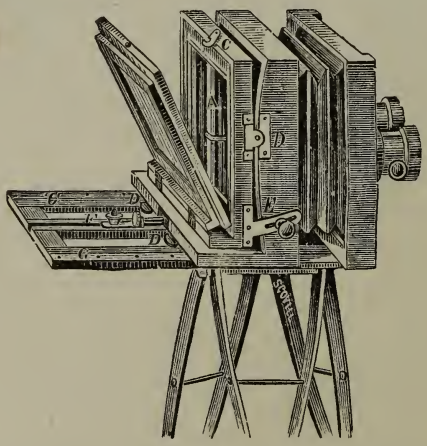
SCOVILL'S
UNIVERSAL SAFETY SHUTTER.

LESSON XX.

STEREOSCOPIC PHOTOGRAPHY.

This class of photographic work, so far as the making of the negative is concerned, is the same in all its details as the negative-making already described.

The only difference in apparatus is found in the use of two lenses, in all respects exactly alike, and placing in the camera, exactly in the centre, a partition of such length and width as to keep the images thrown by the lenses from interfering the one with the other. The usual 5x8 camera is well suited for this style of work; better yet, so far as economy is concerned, is the size known as $4\frac{1}{4}$x$6\frac{1}{2}$.



The cut illustrates fully the style of camera required for this work; in it may be seen the central division and the two lenses.

It is self-evident that, by the use of this camera, two negatives are made of the same view at the same time, one differing

from the other sufficiently to give the relief needed when the print is made, mounted and viewed through the instrument known as the stereoscope.

The difference in the two pictures is well illustrated by holding a book directly in front of the left eye, at the same time closing the right eye. By thus placing the book, the back *only* will be seen by the left eye; now open the right eye, upon doing which the whole of the right side of the book will be seen, thus relief or solidity is given to the object.

Nothing need be here written as to choice of subject, direction of light, development, or any of the manipulations already given, for the reason, as first stated, that all are the same.

After printing, we meet with the important part of this work in the mounting on card-board. Of this the best size is 4x7. When you are ready to mount the pictures, before cutting, turn each one over and mark the one that is at your right hand with an L, for left, and the other with an R, for right, for when mounted on the card the one that is to the right, as printed, is to be placed to the left on the card; keep each pair together, otherwise you will have different shades of toning on one card.

Before cutting out you should have a piece of glass prepared to trim by, to measure $2\frac{3}{4}$ inches wide and $3\frac{3}{4}$ inches high; some workers make it 3 inches wide. As a rule, the first-named width is the best. Some people have difficulty in viewing the pictures when too widely separated. This piece of glass may be cut on top at a right angle to the sides, or may be rounded, as suits the fancy, but it must be smooth along the edges to render the cutting-out clean; it may be had of the dealer if you do not choose to bother with the making.

The trimming may be done with the Robinson Trimmer before described, or with a knife that has a rounding point, and that is perfectly smooth and absolutely free from any roughness on the edge, otherwise it will tear and make ragged the edges of the print.

Place upon a sheet of glass the print to be cut; upon the print place the glass pattern by which the print is to be trimmed, hold the pattern firmly and pass the knife closely

along the sides of the pattern with a steady but quick movement.

In placing the pattern, be careful to have the base-line the same in both pictures, and use on one side or the other the same object, so that each may contain exactly the same view. This, with a little practice and care, can easily be done.

Viewed in the stereoscope, the picture, if properly mounted. will be most charming; the distance, quite perfect.

There are views without end, anywhere and everywhere, that are suited to this sort of work—little bits, wooded lanes, forest paths, waterfalls, brooks over-hung with trees—that possess little charm in a single view, but which are just suited for this style of picture.

Always avoid having the negative very intense; avoid pure whites in the print, for the effect will be snowy; plenty of detail (full exposure); even if the print seems dark, the stereoscope will bring it all out; while if "hard," as we term it (black and white), the effect is not good.

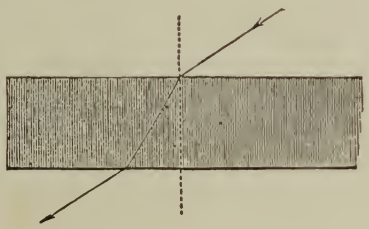
In this style of picture, have, if possible, something prominent in the fore-ground. From this the stereoscopic effect is plainly seen; a bush, a log, in fact any object so placed, seems to lift the whole picture into relief.

LESSON XXI.

LIGHT AND LENSES.

Light is deflected from its straight course when passing through transparent media. If a stick is dipped into water, it appears to be bent out of its known straightness. A ray of light entering glass is bent, and the bending varies with the density of the medium which it enters. Water bends or refracts more powerfully than air, glass more than water, and different qualities of glass, varying in density, refract light with different power.

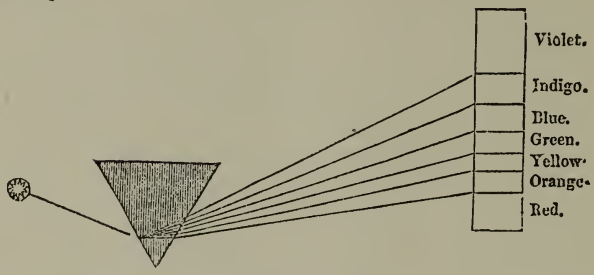
If a light ray passes through a pane of glass, it is bent from the perpendicular when entering, and towards it when emerging.



Refraction takes place at the surface of the transparent medium, where the ray enters, but it does not bend when passing perpendicularly to the flat surface.

Sir Isaac Newton has shown that a ray of sunlight is not homogeneous, but that it consists of several colored rays united, or intermingled, which can be demonstrated by throwing a pencil of sunlight upon an angle of a "prism." An oblong image is then formed and may be received upon a screen. The light passes the prism not in its undivided state

it is broken up into its primary, prismatic colors, and each of these has its own separate degree of bending tendency or refrangibility.



Differently-colored rays refract unequally. Red rays emerging from the prism form an angle with the vision; they diverge. Violet rays are more deflected from their original than the red, and are called most refrangible; the red are the least so. Green rays are more refrangible than red, and less than violet, because spectrum green is situated between red and violet.

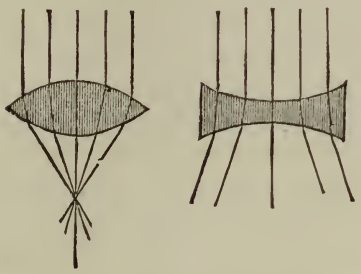
In ordinary photography it would be quite natural to suppose that the most powerful luminous light acted most strongly upon sensitive plates, but if the light is at all yellowish, however bright it may be, its chemical force or actinic power will be but very small. In this way we explain the superiority of the morning sun over that of the afternoon, or the want of chemical action when the setting sun has sunk behind a bank of golden clouds.

The elementary rays of the spectrum can be reunited into white light. If the sun spectrum, emerging from a prism passes through a glass lens, and is then projected upon a ground-glass or white screen, the single rays will combine to make white light.

The deflecting power acts upon the surface of bodies. While the light ray bends on entering and leaving the transparent body, it continues in a straight line when in its medium; hence, it is evident that by modifying the surface of refractors, the rays of light may be diverted at pleasure.

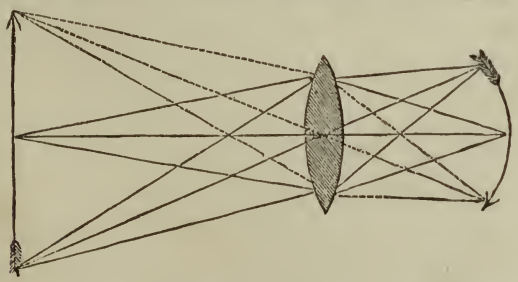
Two prisms, placed base to base cause rays, parallel before entering, to meet in a point, and conversely, prisms placed

edge to edge, to divert them. These phenomena are observed upon curved as well as upon plane surface. Lenses, that is, glasses ground of a curvilinear form, show the same refractive power.



Lenses constructed for the purpose either of concentrating or scattering rays of light, are, in general, made of glass, and are ground with spherical surfaces; the axis of the lens being the line joining the centres of the spheres, and, therefore, a line with respect to which the lens is symmetrical. Regarding the curves in their combination, we distinguish lenses which are called: bi-convex, plano-convex, concavo-convex, or, more frequently, "meniscus," concavo-plane, and double-concave. The first three of these are thicker in the middle than at the edge, and are called "*converging glasses*," because they cause pencils of light that are refracted through them to converge more than they did before; the others are thicker at the edge than in the middle, and are called "*diverging lenses*," because they diverge rays of light when being refracted through them.

The rays of light proceeding through a converging lens from



an illuminated object, cross each other when emerging, and the image formed is necessarily inverted; thus rays transvers-

ing centre or axis of the lens pursue a course either coincident with or parallel to the original.

When an object is placed at some distance in front of a lens, an image is formed smaller than the object, but if the object is advanced nearer to the lens the image increases in size, the focus at the same time receding to a greater distance from the lens. A lens of short focus, placed at a given distance from an object, forms a small image, the rays of light being then strongly refracted. The image becomes larger when the lens is brought nearer, but the lens will be "strained" when going beyond a certain point, and distortion or misdrawing of the picture will result. Therefore, long-focus lenses are constructed to obtain large images. Lenses for taking large photographs have usually a considerable diameter, but it must be understood that the size of the lens has nothing whatever to do with the size of the image. With long-focus lenses, the aperture is increased to admit more light.

A ray of light passing through a lens is analyzed into its prismatic colors, and will give on the ground-glass screen an image with colored fringes. This defect of lenses is called chromatic aberration. To remedy this, media of different densities are employed in the manufacture of lenses, so that different refractive power will establish a balance, by which practically correct work can be done. Such corrected lenses are called *achromatic*—meaning, without color.

Achromatism is the first necessity in any and all photographic lenses. A single non-corrected glass lens possesses *achromatic and spherical* aberration. This second disturbing force is caused by differing refraction of differently-colored rays falling upon various portions of the lens surface. The rays falling on the lens near its edge are bent more suddenly than those that pass through it near the centre, so that each portion of the lens will bring the ray to a focus at different distances. To remedy this, the curvature of the lens is modified; the form showing the greatest amount of this defect—the double-concave, *i. e.*, convex or rounded on both sides—is but rarely used in photography, the meniscus form, convex on one side and hollow on the other, is much preferred.

To meet the chromatic or color aberration, and still further counteract spherical aberration, lenses for photographers are in reality built up of two, and in some cases of three, single lenses, of different degrees of refractive power and quality of glass, cut in carefully-calculated curves, to correct or achromatize the instrument. If the lens is a doublet, like the rectilinear, or portrait, each component part is constructed in this way. Not only the complete instrument is thus achromatized, but also each main component.

The practical result of working with non-corrected lenses will be that the focus is not where it appears to be. In such lenses there are really two foci, the visual and the actinic or chemical focus. The extent of such difference is ascertained by experiment whenever the fault exists. Our modern photographic lenses are, however, so constructed that both foci invariably coincide.

The image given by a lens is not a plane, but tends more or less to a shape like the section of a hollow sphere. To get it as flat as possible, or to approximate in section a straight line, is one of the chief aims of the optician. With a view to this, the proper kind of glass is selected, and the lenses ground according to elaborate calculations, without which another evil, known as astigmatism, may be introduced, by which the definition towards the edge is materially injured, bending the lines of an originally square or right-angular object inwardly or outwardly.

Spherical aberration is also overcome, to a great extent, by placing a diaphragm or stop in front of the lens. Oblique and central rays can, by passing through it, be brought approximately in focus on a plane at right angles to the axis of the lens.

The diaphragm has a further purpose, in that it allows the focus of a distant object and one nearer to the lens to be brought towards one plane. The nearer the object, from which light proceeds, is to the lens, the longer will be the focus.

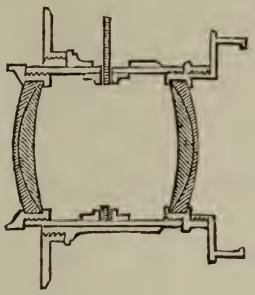
It will be observed that by placing the diaphragm either in front or back of the lens, the effects will be equal, and also that on the aperture of the diaphragm the brightness of the

image will depend. Hence the smaller it is, the less light is admitted, and the time of exposure must be increased. In either position of the diaphragm distortion may occur; in the one case of being in front, the lines forming the square will be turned inwards, and be reversed when the diaphragm is placed on the back of the lens. But by placing a lens on either side of it, the distortion may be entirely obviated. Upon this principle doublet lenses, with central stops, are constructed. When very small diaphragms or stops are used, say of an aperture equal to the fortieth part of the focal length of the lens, allowing a distance of four feet for every inch of focal length, everything beyond that distance will be pictorially sharp. If the lens of a camera, producing pictures of 4x5 inches, having a focus of six inches, and a small diaphragm is then used, the depth of pictorial delineation is such that everything beyond twenty-four feet from the camera will be well defined, when an object at that distance is sharply focused. From this it will be seen that the shorter the focus of the lens the greater will be the pictorial depth.

The compound achromatic meniscus lens is the form generally used for landscape work. It is constructed of a bi-convex lens of crown glass, and a bi-concave of flint glass, the contact surfaces being of equal radius are joined with a cement, generally Canada balsam. To this class of lenses belong the "Waterbury series," an instrument of the highest order for landscape work. In it the diaphragm is placed in front, allowing to pass those rays only by which a perfectly sharp picture can be secured.

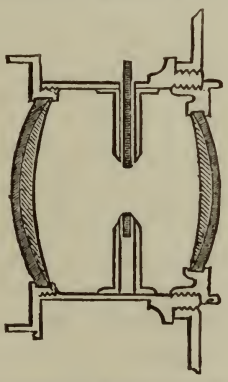
Some opticians construct single lenses of flint glass of different degrees of density or refractive power, establishing achromatism by that means, while others obtain the same effect by the use of crown and flint glass of special composition. These instruments are doublets, and are formed by a symmetrical pair of achromatic lenses, the concave surfaces of which face each other. The diaphragm is placed centrally between the two. They work sharply with an aperture equaling about one-seventh or one-eighth of the focal length, and are well adapted for the photographing of groups, single portraits, land-

scapes and reproductions. The Wale "Universal" belongs to this class.



By making the lenses much thicker and giving them, also, shorter radii of curvature, and placing them closer to each other, a very wide angle of view (from 90 to 110 degs.) is obtained. Wide-angle lenses consist of a symmetrical compound, each achromatic lens of which is composed of a plano-convex crown, placed in contact with a bi-convex flint, the concavity of the side of which next to the crown glass being only very slight.

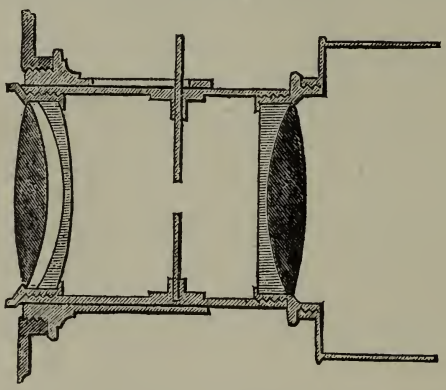
The Morrison Wide-angle Lens consists of an achromatic meniscus as the front, and a single meniscus as the back lens; the front one being over-corrected to an extent sufficient to counter-balance the non-correction for achromatism of the back lens. It includes an angle of great width.



Wide-angle lenses are mainly used for interior views.

Of portrait lenses it is required that they transmit the greatest

possible amount of light, so that by a short exposure a detailed negative can be made; and they should give extreme sharpness with a large opening. The relation existing between the working aperture and the focal length of the lens is termed angular aperture, and it is essential that it be very great in a



good portrait lens. Professor Petzval discovered the means for establishing these conditions, and his lens consists of a plano-convex (or nearly so) form, with the convex side near the object to be taken. The inner or contact surfaces of the constituents are not of the same radius of curvature, and, besides, are separated from each other to a slight extent. This produces negative spherical aberration, or aberration of an opposite nature to the positive aberration, which produces the effect of lengthening the oblique rays and thus flattening the field of delineation.

Newer portrait lenses are principally constructed upon the Petzval plan.

Several opticians, among them Mr. Morrison, have lately constructed lenses with a back combination differing from that described above; the negative aberration, necessary for flattening the field, is obtained by the non-concentricity of the contact surface, by which a meniscus of air is always interposed between them. Unless the two back lenses are kept screwed closely together, a sharp picture cannot be obtained. A separation of the lenses introduces a degree of aberration inimical to sharp definition.

In choosing a photographic lens, the purpose for which it is required must be kept in view. A portrait lens has properties which are not essential for landscape work, and which even might prove detrimental.

Several differently-constructed lenses are now made which answer the requirements for all photographic work.

LESSON XXII.

PHOTO-MICROGRAPHY.

PHOTO-MICROGRAPHY is the art of making enlarged images of microscopical images by photography.

Micro-photographs, on the contrary, are microscopical photographs, or reduced images, of large pictures or objects, and have little value, as a rule, excepting as curiosities.

In the production of photo-micrographs, the object to be photographed is always illuminated by transmitted light. Solar, electric, magnesium, or ordinary gas or lamp-light may be employed, and are of value in the order stated, sun-light being best.

Inasmuch as the actinic power of the light employed is weakened, directly as the image of a given object is magnified, only the more brilliant illumination will be suitable for the higher amplifications of the microscope.

Microscopical enlargements are usually stated in diameters, that is to say: If the image of an object one-hundredth of an inch square is made to appear one inch in diameter, it is said to be magnified one hundred times (×100) only, notwithstanding the apparent superficial area has been increased ten thousand times. This is for convenience and brevity of expression in writing.

Microscopical objects for photographical enlargement are invariably of the utmost thinness, and pictures therefrom possess little or no perspective; and, while the image is expressed in outline, this does not preclude the possibility of the existence of very great detail.

The chief obstacle lies in this: That objects to be pictured must be generally translucent, in order to secure illumination by transmitted light, and, as a consequence, the details of

structure are of only varying degrees of translucency, and so the contrasts in the projected image are weak.

The essentials of the apparatus are:

(*a*) Arrangement for securing the light.

(*b*) Means of concentrating the last.

(*c*) Mechanism for adjustment of the image forming combination.

The principles of photo-micrography are best conveyed by first employing the most simple apparatus and being content with moderate magnification. Such an apparatus is provided in the ordinary magic lantern attached to the compound microscope.

The source of light here selected is that from a single-wick kerosene burner.

The flame must be placed edge-wise in the optical axis of the apparatus. This is important, in order that the full intensity of the light may be secured without interference of the feebly-illumined outer portions.

The concave mirror, if supplied with the lantern, must be removed, inasmuch as the rays reflected from such surface would not be focussed coincidently with the rays directly impinging upon the condensing lenses.

A thin, blackened, metal plate with a half-inch circular perforation should be placed between the edge of the flame and the condenser, and close to the former, for the same reason as indicated in second paragraph preceding.

The rays from the flame are collected by the lantern condensers, and thereby concentrated upon the object upon the stage of the microscope.

The centre of the lamp-flame must be in the exact optical axis of the condensers and of the microscope body; otherwise, the object will be obliquely lighted.

The heat-rays, which are now concentrated upon the object, to its detriment, should be intercepted by placing a vessel with plate-glass sides, containing a dilute solution of ammonio-sulphate of copper, in the path of the light and near the stage of the microscope. This improves the definition by intercepting certain illuminating rays which possess the actinic

power. The blue cell may be removed while focussing, if found necessary, in consequence of its cutting off too completely the visual rays.

If the microscope be provided with an achromatic substage condenser, its use will improve the illumination. A half-inch objective may be employed as a condenser with excellent results.

In selecting objects for photo-micrography, secure such as present sharp outlines and clear detail. Minute insects, or portions of larger ones, diatoms, and some animal and vegetable histological slides will be preferred. Potato-starch makes an excellent object, and may be prepared as follows: Scrape the freshly-cut surface of a raw potato, and convey the merest speck of the fine scrapings to the centre of a glass slip. Add a single drop of clean water and drop on a thin-cover glass. The glasses must be scrupulously clean. The cover will adhere sufficiently without cementing and will not slip when the whole is placed upon the vertically-positioned stage of the microscope. The starch granules present concentric markings* which afford a good test for the defining power of the higher-power lenses (such as the one-fifth inch).

Any good microscope objective may be employed for photographical purposes. Begin with the one-inch lens and a small insect—a flea, for example—mounted as a translucent object. It is not necessary to have lenses specially-corrected for photography. The objectives of our first-class opticians almost invariably give good photographic results. Do not waste time with inferior, poorly-corrected French lenses.

The image formed by the objective should be received directly upon the focussing-glass of the camera. Be sure that the connection between the camera and the microscope is absolutely light-tight. This is best effected by tying a velvet tube around the microscope body.

Remove the eye-piece; it will amplify the image without increasing the definition. Aim to secure a sharp negative, with good contrasts, and of medium size. The half-plate is

**Practical Microscopy.* (New York: William Wood & Co.) By Maurice N. Miller, M.D. Describes the method of preparing objects like the above, besides animal tissues.

sufficiently large, and the quarter will indeed be very satisfactory in most instances. Enlargements upon bromide paper will be much more satisfactory than the results of attempts to amplify directly.

The size of the image upon the focussing-screen depends upon (*a*) the focus of the objective; (*b*) the distance between the last and the focussing-plate. As has before been stated, the illumination will decrease according as the camera-bellows is drawn out. Commence with a medium distance—say twelve inches.

If the amplification be considerable and the contrasts feeble, the image connot well be focussed upon the ground-glass. Substitute a piece of plate-glass, having first thinly smeared one side with tallow. Focussing should invariably be done with a magnifying lens.

The light must be adjusted for centrality. This is done once for all if the lamp can be fixed in the lantern.

Exposing must not be done by drawing the slide of the plate-holder, as the adjustments are thus disturbed. A piece of blackened card-board, interposed between the lantern-condenser and the microscope-stage, should be removed for exposing. This avoids all danger of jarring during the action.

The period of exposure can only be determined by experiment. Construct a table of exposures from actual trials, noting (*a*) the objective used; (*b*) the character of the object photographed—as to translucency, color, etc.; (*c*) whether with or without the secondary—sub-stage—condenser; (*d*) the length of the camera, or distance between the microscope objective and the sensitive plate.

The definition must be perfected by attention to the stage diaphragm and the position of the secondary condenser. The rule regarding the employment of the diaphragm is: The higher the power employed, the smaller the opening used. The illumination must be perfected by racking the sub-stage condenser until the best effect is secured. If the picture develops unevenly*—quickly in the centre and slowly around

* This may result if the inside of the tube (body) happens to be left—by the negligence of the maker—bright, so as to reflect the peripheral rays upon the sensitive film; and it may be corrected by introducing a tube made of blackened paper.

this—the field has been improperly illuminated, and the condenser must be racked to and fro until the light appears of equal intensity in the different parts of the field.

Microscope objectives, capable of adjustment for thicknesses of cover-glass, are invaluable for purposes of photomicrography, and the adjustment does not differ from the same when the lens is employed for ordinary visual work.

Immersion objectives may be used as well with the microscope body in the horizontal position.

LESSON XXIII.

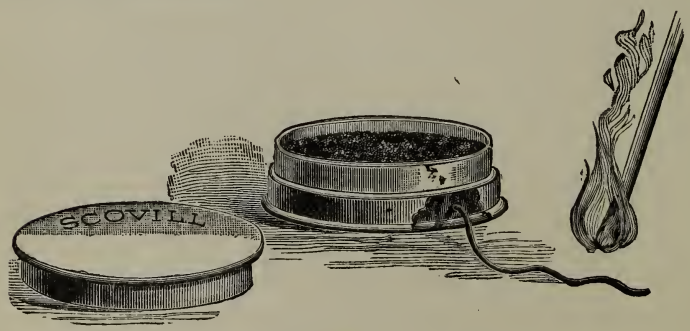
PHOTOGRAPHING BY ARTIFICIAL LIGHT.

Dark days, cloudy weather, a desire frequently, even the necessity, to obtain photographs of but sparingly-illuminated objects or of localities in total darknesss, have led to extensive experiments with a variety of artificial-light sources. Among the many methods proposed as substitutes for day-light are the electric arc and incandescent lights, light resulting from the burning of magnesium, the calcium, oxy-hydrogen, Bengal pyrotechnic white fire, the ordinary gas, and petroleum flames. Wherever long exposures are required, and the cost of installing an electric system is of but secondary consideration, the arc-light has held its own. For quick and instantaneous work, for the amateur and scientist, magnesium has gained an immense popularity over all other artificial lights, because of its cheapness, its simplicity, and the brilliancy and highly-actinic quality of its light. Early and very successful experiments with magnesium wire or ribbon had shown the enormous light-force emanating from this burning metal, but owing to its then very high price, the photographer was debarred from using it in daily practice; still, it was occasionally resorted to in urgent cases.

After it had been learned how to reduce the metal from its natural combinations by electrolytic processes, its high price suddenly fell, and it became available to the photographic public. The actinic force of the magnesium flame is increased by burning the metal with the aid of oxygen directly. To do this efficiently, magnesium, reduced to powder or fine filings, was mixed by many experimenters with purveyors of oxygen, more or less explosive and otherwise dangerous, but realizing the desire of obtaining a more perfect light.

Most of the substances furnishing oxygen, being poisonous and giving rise to the evolution of dangerous and obnoxious gases, necessarily raise just objections against their use. Others again do not contribute to perfect combustion of the whole metal, and reduce the light-force; while gun-cotton, used as a fusee, imparts a decidedly yellow color to the flame, making it non-actinic.

The instructor of the Chautauqua School of Photography prepared a magnesium flash-light compound, and demonstrated its practical use with perfect success. It is absolutely safe in every respect, and of enormous luminous force. Divided into charges of about 20 and 40 grains, respectively, it is prepared and sold in form of little card-board cartridges, and ignited by a burning match through a fusee reaching the centre of the cartridge.



Scovill's Magnesium Cartridges.

The compound is consumed completely within the thirtieth part of a second. For single portraits, groups of from five to eight persons, or the interiors of parlors, library, etc, a single cartridge of 20 grains furnishes sufficient light at a distance of from twelve to twenty-five feet. With a Wale Universal or a Gundlach Rapid Rectigraph of ten inches focal length, and $\frac{f}{16}$ stop, or a Waterbury B with $\frac{f}{15}$ diaphragm, perfect exposures are obtained with this light.

For larger groups, in localities of more extended dimensions, or for interiors of churches, lecture and school-rooms, the quantity of the magnesium powder must be increased proportionately.

To light a portrait with taste, and to give it roundness and plasticity, the magnesium light demands more care and judgment than day-light. One can make a good portrait—say of the size of a cabinet, with the objectives generally used for portraits, by placing the light at a distance of from five to eight feet from the subject. The student should remember that, "*the nearer to the source of light, the stronger and sharper will be the shadows cast.*" Hence, we must soften the shadows by removing the light, with, of course, a sacrifice of some of its force. The light being comparatively powerful at as near a distance as five, six or seven feet, we can reduce its force, and diffuse it over a large space, by interposing between it and the subject a screen of white tissue-paper, or a thin fabric (gauze). On account of the close proximity of the light, the subject must be removed so far from the background as to avoid shadows of the sitter to fall upon it. The light, placed towards the sitter at an angle of 30 degrees, must be so far removed from the apparatus as to prevent light from entering the lense, but not so far as to destroy plastic effects upon the subjects. Strong shadows will occur with day-light as well as with the magnesium flash, on that side of the subject opposite to the light-source, and to counteract this effect, we resort to the side-screens described in the lesson on Portraiture.

To find sharp focus in a room, lighted by ordinary gas or petroleum lamps, is sometimes quite difficult. But the task may be facilitated by placing a burning candle or taper in close proximity to the sitter's face, and by then focussing on the flame. In large rooms or halls, the same method can be made available; but there it will be better to distribute a series of lights over the space desired sharp in the picture, and focus on them.

Focus having been secured, the lens is capped, and the slide drawn from the plate-holder; all lights are then extinguished, the cap removed, and the magnesium cartridge or other preparation is ignited. The lightning-like flash which follows endures about one-thirtieth of a second; after which the lens is recapped, the slide inserted, the room relighted, and the plate carried to the dark-room for development.

The only perceptible product of the burning of magnesium is oxyd of magnesium, identical with the well-known calcined magnesia; it rises in a white cloud, but is soon dispersed. Before the smoke has entirely been dissipated, it is not advisable to proceed with another exposure. The finely-divided particles of magnesia suspended in the air are apt to cause an impression (fog) upon the plate.

As a developer for plates, exposed by the magnesium flash-light powder, the student is referred to the formula appended to Lesson XIX on landscape photography. The precautions required by all instantaneous exposures should be carefully observed in this work as well.

LESSON XXIV.

EMULSION MAKING.

We have necessarily gone through a variety of operations in learning how to make photographs; but the basis of all our various productions on paper, glass, and other substances is, as we have seen, the negative made upon a glass plate, coated with a substance called bromide of silver gelatine emulsion, the preparation of which we still have to learn.

It is not the purpose, in this lesson, to give a full account of how to prepare light-sensitive gelatine emulsions, and how to coat plates with them to be ready for the amateur's work, for good and extended works already exist on this subject which are at the disposal of students*; it is merely intended to show what gelatine emulsion is, and to give an outline of the operations necessary to produce a light-sensitive plate, in the modern sense of the word.

Before we enter into this description, it may be well to mention that, previous to the year 1880, photographers prepared their own plates, as occasion demanded; a glass plate, coated with mediums, carrying within them metallic iodides, bromides and chlorides, were subjected to the action of a solution of nitrate of silver, thus producing combinations of iodine, bromine, or chlorine with silver, and a light-sensitiveness of the film resting upon the glass support. By exposure to light and development, good printing negatives were secured from these films. Starch, gums, gelatine, albumen, but principally collodion (a solution of gun-cotton in alcohol and ether), were the mediums adopted to carry the sensitive salts.

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* *Photography With Emulsions*, by Capt. Abney; and *Dry Plate Making for Amateurs*, by Dr. Geo. L. Sinclair.

It was then suggested to mix the nitrate of silver in solution with the bromides, iodides or chlorides (haloids, as they are termed collectively), of alkaline metals, mixed intimately with a solution of gelatine, so as to keep the correspondingly-formed silver haloid suspended, in the form of a milky liquid or emulsion.

To Dr. Maddox* is due the credit of having first prepared a serviceable gelatine emulsion. The silver haloid which he originally used was the bromide, but later reseaches, mainly those of Victor Schumann and Captain Abney, have proved that the addition of iodide to the bromide of silver increases the sensitiveness of the plate and contributes much to perfecting the final result.

Probably all writers on modern photography, and scores of practitioners, have made emulsions successfully. The operation is interesting and instructive enough to attract the attention of the studious amateur to try his hand at emulsion-making.

For our purpose, it will be sufficient to describe the making of emulsion, according to one or two formulæ which have given entire satisfaction wherever they have been adopted.

A very popular method is that of Mr. Henderson's, as modified by Chas. Scolik, which was described as follows in the *Photographic Times:*

The Henderson emulsion is indeed excellent, particularly in the results, giving absolute clearness, beautiful high-lights, and well-defined shadows. With all these good qualities, it shows a sensitiveness of from 20 to 21 deg. Warnerke, which is equal, therefore, to all commercial instantaneous plates.

We prepare our emulsion in the following way: In a Florentine flask of 1 litre capacity† we dissolve from 3 to 4 grams Heinrich's gelatine in 150 c.c.m. of distilled water, at a temperature of 50 deg. C., and add 1 gram crystallized citric acid (recently citric acid has been omitted). After perfect dissolution, 7 grams of carbonate of ammonium, previously

* See Appendix of *History of Photography*, by W. Jerome Harrison, F.G.S.

† We retain the decimal weights and measures in order to give the formula without the least deviation from the original.

reduced to a fine powder, is added, which causes a violent effervescence; further add 45 grams bromide of ammonium and 8 c.c.m. of a 10 per cent. iodide of potassium solution, and finally 420 c.c.m. alcohol (92 per cent.) mixed, with 18 c.c.m. ammonia (0.91).

In another flask we dissolve 60 grams nitrate of silver in 300 c.c.m. of distilled water. The two solutions, prepared in day-light, must now be removed to the dark laboratory, when the silver solution is added in small portions, and by constant agitation, to the alcoholic bromide solution. During the first two hours the mixture is frequently shaken up, the flask being closed with a well fitting stopper to prevent the volatilization of the ammonia during the ripening. Allow it to stand over night, and, on the following morning, swell 84 grams of Heinrich's gelatine in just enough water to cover it; strain off the superfluous water, melt the gelatine, and add it to the silver solution, warmed to 35 deg. C., mix well together, and pour finally in a flat porcelain dish. When allowed to stand for a long time, the emulsion, on account of the alcohol, is rendered a hard and tough mass; it is better, therefore, to chill only for two or three hours, according to the temperature. If too hard, it is difficult to reduce to shreds or press them into nodules. Afterwards wash for three or four hours in from ten to twelve changes of water, press out the water in a linen bag, and melt in a beaker glass, filter and coat.

Of the highest importance in emulsion-making is the temperature. In our laboratory we ripen emulsion in ten hours, at a temperature of from 25 to 28 deg. C. in summer, and in winter by from 16 to 22 deg. C., in eighteen to twenty-three hours. Dr. Stolze has correctly observed that, at a temperature of less than 20 deg. C., only 17 to 18 deg. Warnerke can be reached. With the proportions of time and temperature employed by us, 20 to 22 sensitometer numbers can be easily obtained.

It is an interesting fact that alcoholic emulsions digested or ripened at higher temperatures, about 40 or 50 deg., will never give satisfactory results. Alcohol favors ripening when alkali

(ammonia) is present. But at a temperature beyond 25 or 30 deg. C., a variety of perplexing difficulties occur. It is not safe to attempt ripening a Henderson emulsion at a temperature near 50 deg. In fact, it is almost impossible to do so. Granulation of the emulsion, fog, feeble and flat negatives are the results.

It is equally necessary and important to consider the amount of water used for swelling. Not more than is absolutely requisite should be taken up. Swell for fifteen to thirty minutes, and no longer. Remove carefully all water not absorbed, and add only very small quantities at a time to the silver solution at moderate heat.

Quick and perfect chilling is essential. This is best done by placing the vessel containing the emulsion upon ice. When shredding, the particles should appear to be compact and solid; if not sufficiently chilled, the wash water will froth, and the emulsion will become soft and slippery in consequence of having taken up too much water. Such emulsions granulate, and their sensitiveness decreases materially.

The same must be said of diluted emulsions. It is erroneous to say a diluted emulsion retains the original sensitiveness. If, after washing, all superfluous water has been thoroughly removed, plates may be prepared with a thin coat. This dries more rapidly and offers advantages in operating which can hardly be sufficiently estimated.

Another emulsion, which is very popular in America, is that of Prof. Dr. Joseph M. Eder, and is prepared as follows:

Dissolve in a Florentine flask

Bromide of ammonium	20 grams
Bromide of potassium	24 grams
Solution of iodide of potassium 1:10	5 to 10 c.c.m.

And add, in winter,

Hard winterthur gelatine	45 grams
Heinrich's gelatine	45 grams

In summer,

Hard winterthur gelatine	65 grams
Heinrich's gelatine	25 grams

With sufficient water to allow the gelatine to swell.

Into another flask place

Nitrate of silver cryst.	60 grams
Distilled water	550 c.c.m.

And, when thoroughly dissolved, add sufficiently strong ammonia till the brownish precipitate formed is re-dissolved, being careful not to use more ammonia than is absolutely necessary. Both of these operations may be performed in day-light; afterwards remove to the dark-room. Both of the solutions are then heated to 150 deg. F., and the silver solution, in very small portions, drop by drop, and by constant agitation, added to the gelatine, thus effecting a uniform and very fine precipitate of the silver haloids formed. The silver flask is rinsed with 100 c.c. warm distilled water, and the rinsings added to the rest.

The entire mixture, or emulsion, is then digested upon a water-bath of a temperature of 100 deg. F., till a small portion of it, spread upon a glass plate, shows a blue color when viewed by the transmitted light of a candle-flame.

The emulsion, being now complete, is poured into a flat dish or tray, allowed to cool or chill, and to stand for twenty-four hours, during which time ripening continues.

Emulsions made by either of the two-mentioned formulæ contain the results of the decomposition of the soluble haloids and the formation of the insoluble silver salts, *i. e.*, nitrate of ammonia and nitrate of potassium, an excess of free nitrate of silver, and the insoluble sensitive silver haloids. While the latter remain, the former soluble substances must be removed—that is, the emulsion requires washing. To do this the chilled gelatinous mass is cut up into shreds by means of a horn or bone paper-knife, or pressed into nodules, through coarse canvas.

Swelled gelatine, or the tremulous emulsion, being soluble at about 80 deg. F., the operation of nodule-pressing must be performed under iced water. Shreds or nodules are then washed for several hours either in repeated changes of ice-water, or in a running stream of it, till all soluble matter is removed.

A very convenient method to wash small quantities of emulsion—about as much as an amateur will take in hand—is to place the shreds in an ordinary earthenware tea-pot, tie a coarse hair cloth over the opening, place the lid upon it and attach to the spout a rubber hose, through which ice water is allowed to run.

Washing completed, the emulsion-shreds are spread upon a coarse canvas, fastened to a tentacle, and all water is allowed to drain, which may take hours; collected in a beaker-glass, re-melted by moderate heat, and filtered. To remove mechanical impurities, and to keep out coarse particles of silver haloids, filtering becomes an absolute necessity. A variety of ingeniously-devised filters for emulsions have been constructed, but for our experiments, on a small scale, perfect filtration can be effected by pressing the melted emulsion through a clean piece of chamois leather, or by allowing it to run through flannel tow. Of course, a tolerably high temperature must be maintained in order to keep the emulsion in liquid form. If the emulsion has been kept for any length of time before coating on the glass plates, an antiseptic is required to keep it in good condition. Small quantities of thymol or carbolic acid in alcohol do this very well.

The glass plates to be coated must be scrupulously clean. Wash them in a strong solution of soda, and, after allowing them to stand in diluted nitric acid 1:3, rinse them off well and dry upon a rack.

Before coating, the plates must be furnished with a substratum. Gelatine alone, or when mixed with a trace of bichromate of potassium, and exposed to light; pure albumen, or albumen with a little chrome-alum; a thin solution of potassium water, glass in water, or rubbing the glass in the same solution till dry, have been recommended, and are used with success.

The coating and drying-room must be absolutely free from dust, and be well ventilated, sufficiently dark, and heated to 70 or 75 deg. The plates must remain in the room long enough to assume its temperature before they are coated with the emulsion, which is heated higher than the temperature of the

room. To coat plates of the same size uniformly, the emulsion must be measured out for each individual plate, half an ounce being enough for an 8x10 plate. If the emulsion refuses to run smoothly over the plate, assist it with a glass rod.

After coating, the plates are laid upon a cold marble slab, perfectly leveled, and allowed to chill, after which they can be set on edge for drying. This requires from eight to ten hours.

Longer drying is likely to produce fog.

As exposure to ruby light, when extended for a very long time, naturally affects the plates, they should be dried in an absolutely dark closet, through which a strong current of dry and cool air is allowed to pass, and in which the plates are set up with sufficient space between them.

It is never advisable to open the drying-closet before the plates are presumed to be perfectly dry. The slightest change of air and temperature will have a marked effect upon them. Dried gelatine emulsion plates are best kept in grooved wooden boxes, well shellacked inside and out.


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APPENDIX

On the Nature and Use of the Various Chemicals and Substances Employed in Photographic Practice.

BY PROF. CHARLES EHRMANN,

Instructor of the Chautauqua School of Photography.

Acid, Acetic, the acid of vinegar, gets its name from the Latin word *acetum*, vinegar. It is prepared from wine and other alcoholic liquids by exposure to air at a high temperature. The alcohol, by oxydation, is entirely changed in its composition, and converted to its acid derivative. The acid is produced in large quantities by a destructive distillation of hard wood—oak or beach; but, owing to a great variety of incidental products and impurities, lengthy processes are required to obtain it in a pure state and concentrated form. It is generally made by distilling it from the crude acetate of soda or acetate of lead.

Pure acetic acid should leave no residue after evaporation, and give no precipitate with either the nitrate of silver or the chloride of barium.

The acid of commerce, or when in the most concentrated form, "glacial acetic acid," is employed in photography to liquify gelatine; as a restrainer, principally in the wet-collodion process; to eliminate iron from the paper support of gelatine emulsion films; and for various other purposes, especially when in connection with the bases.

Acid, Boric or *Boracic*, occurs naturally in the waters of volcanic lagoons. It crystallizes in transparent, colorless plates,

and dissolves in 25 parts of water. It is one of the most powerful restrainers in alkaline development.

Acid, Chromic, consists of oxygen and a metallic element, "chromium," named thus on account of the beautiful colors of its many salts.

Chromic acid, in its pure state, is used in Obernetter's process to reproduce negatives from negatives (see *The American Annual of Photography*, Vols. I and II); and, in combination with potassium or ammonium, in the photo-mechanical printing methods, where it acts as a powerful oxydizer upon organic bodies.

It crystallizes in fine, red needles, which are deliquescent and very soluble; is sensitive to light, and is decomposed by it with the liberation of oxygen.

Acid, Citric, is found in the juice of limes, lemons and several other fruits, from which it is extracted by combining the acid with carbonate of lime and liberating the acid from the citrate formed with sulphuric acid, by evaporation and crystallization.

Citric acid is a white, crystalline body, permanent in dry air, but attracting moisture in dampness. It is easily soluble in water, also in alcohol. The aqueous solution will get mouldy after a short time. If adulterated with tartaric acid, which it very much resembles, a sumptuous addition of carbonate of potash to its solution will cause a white precipitate of bi-tartrate of potassium, or cream of tartar.

Citric acid, like other organic bodies, rich in carbon, has the property to reduce the oxides of precious metals.

It is used in combination with the pyrogallol developer; for the preparation of durable silvered albumen paper; to clear bromide prints from adhering iron; and, in combination with bases, for various other purposes.

Acid, Gallic, from which pyrogallol is most frequently made, is a true acid, is soluble in 100 parts of cold water, and easily soluble in alcohol. Its action as a developer is not as powerful as its derivative, pyrogallol, but has been frequently recommended to intensify feeble negatives when combined with acetic acid and a trace of nitrate of silver. Recently it has been proposed as a slow-acting developer for the production of black and white negatives, with very promising results.

Acid, Hydrochloric, commonly called muriatic acid, is composed of two elementary gases—chlorine and hydrogen. The acid is prepared by the action of sulphuric acid upon common salt, chloride of sodium, and the evolved gas, when cooled, is absorbed by water. In olden times, sea-salt was exclusively employed for the purpose, hence the name, "muriatic," from the Latin *muria*, brine or salt water.

Hydrocholoric acid, when pure, is colorless, of a pungent, suffocating odor. It leaves no residue on evaporation, and should give no precipitate or opacity with dilute solution of chloride of barium. Its use in photography is very extensive. As a solvent for metallic bodies, in combination with nitric acid to prepare chloride of gold and chloride of platinum; to precipitate chloride of silver from waste solution or wash waters; as an addition to the alum clearing-bath; and whenever a free mineral acid is required, the nature of which is a matter of indifference, since it is not liable to alter bodies by oxidation, as nitric acid will do, nor to form insoluble compounds, as occurs with sulphuric acid. For the cleaning of old bottles, funnels, or other glass and earthen-ware, as trays or evaporating dishes, it is an invaluable medium. It is not a bleaching agent, but decomposes in sunlight, with the separation of free chlorine.

Acid, Nitric, is composed of nitrogen and oxygen. In very small quantities, it can be formed directly by passing a series of electric sparks through a mixture of 7 volumes of oxygen and 3 volumes of nitrogen. Bound to bases, the acid is found naturally in enormous quantities, as saltpetre, nitrate of potassium, Chili or cubic saltpetre, nitrate of sodium, etc. It is manufactured, on a large scale, by allowing sulphuric acid to act upon any of these nitrates.

The pure, concentrated acid does not attack copper, lead, tin or silver, but when mixed with water, or when containing nitrous acid, or still lower oxides of nitrogen, a dissolution of the metal takes place speedily, and red vapors of nitrous acid are evolved. The metal is thus oxidized, the oxide combining with the nitric acid in excess, and forming the corresponding nitrate. Nearly all the nitrates are soluble, neutral, and not capable of forming double salts.

Nitric acid is extensively employed in photography. With it we prepare the nitrate of silver, copper, lead, etc.; we use it to make gun-cotton, or pyroxyline, when it is combined with sulphuric acid; with it we clean glass plates preparatory to coating them with sensitive substances; for the preservation of pyrogallic solution; in various developers; and as natural nitrates in many other operations.

One volume of nitric acid and two volumes of hydrochloric acid constitute the nitro-muriatic acid, formerly known as *Aqua Regia*, capable of dissolving gold, as when we prepare chloride of gold. The process taking place is probably due to a liberation of chlorine gas, which, in *statu nascenti*, combines with gold, while nitrous acid and water are simultaneously formed.

Acid, Nitrous, constitutes principally the red fumes arising when metals are dissolved in dilute nitric acid. Combined with bases, the acid forms nitrites. Nitrite of silver is formed sometimes when nitrate is being fused. Of other nitrites, none need be mentioned in connection with photographic operations except the potassium salt, which is used for preparing ready-sensitized paper.

Acid, Oxalic. Combined with potassium, this acid is found naturally in a little plant, growing in shady forests, and known by the name of wood-sorrel (*oxalis acetosella*). It is combined there in excess of the potassium, as a bin-oxalate. This acid, having found extensive employment in chemistry and the mechanical arts, and its natural source being but extremely limited, chemists have resorted to prepare it by artificial means and produce it by treating sugar, starch, gum, rice, and other substances with nitric acid. At present, it is largely made by heating saw-dust with caustic potash to 400 deg. F., and a subsequent treatment of the resulting mass with carbonate of lime and sulphuric acid.

It is a colorless, crystalline substance, resembling Epsom salts in its appearance, but is very poisonous. Care should, therefore, be taken whenever it is handled by inexperienced persons.

In its pure state, it is used to acidify the oxalate of potas-

sium solution, with which the ferrous-oxalate developer is prepared; it is added to the alum clearing-bath; pyrogallic acid solutions are renewed with it; and stains on the fingers, caused by pyro-developer, may be removed by it; and it is very valuable for cleaning brass or copper implements.

Combined with potassium. and eventually with iron, it is a constituent of the oxalate developer, used largely by all photographers not English or American.

Acid, Pyrogallic, or pyrogallol, a substance which is employed in enormous quantities as a developing agent, is, properly speaking, not an acid, because it shows no acid reactions, notwithstanding its capability to form feeble combinations with some bases, a property common to several of the indifferently-acting organic compounds. For this reason, the name of pyrogallol has been substituted for pyrogallic acid.

It is prepared by subjecting gallic acid, or other substances, to dry distillation or sublimation, but can be made also by subjecting finely-pulverized Aleppo galls to a similar process Pyrogallol is a white, voluminous and crystalline substance, easily soluble in water, alcohol and ether, and very poisonous; two grains of it will kill a dog.

Owing to a property, which it also shares with many other organic bodies, to reduce precious metals, like silver, from their combinations, to de-oxidize them, it is a powerful developing agent. With the wet-collodion process it is used with citric acid; with dry gelatine-emulsion plates, whose development is the result of true chemical action, alkalines are added to its solution, to make it active.

Up to a certain point the addition of ammonia, soda or potash accelerates; beyond that it results in gray, red or green fog, according to the kind of alkali taken, and reduces even the silver of the emulsion so far as to give the plate a perfect metallic lustre. To prevent pyrogallol in solution from decomposition, we add to it sulphites, sulphurous, or other acids. A pure, aqueous solution turns black speedily by exposure to air and light. Ferric salts turn it yellow; ferrous salts, bluish-black (ink); chlorine also blackens it, but iodine has no influence.

Acid, Salicylic, is a white, crystalline, voluminous powder; is obtained from the bark of certain species of the willow-tree. It has been used to preserve gelatine emulsion, and, for a like purpose, it is added to pyrogallol solutions.

Acid, Sulphuric, composed of sulphur and oxygen, is made by burning sulphur and oxidizing the resultant vapors of sulphurous acid by means of nitrous acid. The operation is performed in a series of lead chambers till the acid obtained has gained sufficient concentration.

It is a dense, oily, colorless, inodorous liquid, and strongly corrosive, acting destructively upon organic tissue.

Pure sulphuric acid is used to acidify sulphate of iron solution; otherwise not very extensively, excepting when combined with bases or in the preparation of other chemicals, like gun-cotton, etc.

Acid, Sulphurous, a gas, is prepared by heating sulphuric acid, water and charcoal, and absorbing it by water, of which 40 volumes will take up about 1.

This solution of the acid in water is known by the name of sulphurous acid water.

The commercial article is a clear, colorless liquid, with a strong odor of burning sulphur, and, owing to its great attraction for oxygen, will readily turn into sulphuric acid when exposed to the air.

Sulphurous acid prevents the decomposition of pyrogallol in solution, and is very valuable as an agent to bleach pyro-stained negatives.

Acid, Tartaric, occurs naturally in many kinds of fruit, but principally in unripe grapes. It is a white, crystalline solid, of strong acid properties, and, if diluted with water, of very agreeable taste. It is easily soluble in water, also in alcohol.

Its photographic use is but limited, though it has been of late successfully employed as a restorative to spent ferrous-oxalate developer.

Albumen is a substance largely found in the animal and vegetable kingdoms. That separated from the blood of quadrupeds is occasionally used; much more so, however, the whites of birds' eggs. It is soluble in water, but becomes

insoluble or coagulates when exposed to the temperature of boiling water. Heated at a low temperature, it evaporates to a yellow, friable mass, which is again soluble in water. Alcohol, and some of the metallic salts, coagulate it also. With nitrate of silver, it forms a white precipitate, albuminate of silver, with the property to turn red in sunlight.

Albumen is used for various photographic purposes. With it substrata for sensitive collodion or gelatine plates are formed, and enormous quantities are expended in preparing albumenized paper. In combination with bichromates it is employed in several photo-mechanical printing methods, and with it are made, to the present day, the sharpest and most delicate lantern-slides and transparencies. With sensitized albumen the first negatives were made upon glass, long before collodion was thought of.

Alcohol is a product of various fermentations. When certain vegetable juices, containing sugar or starch, are exposed to a moderately high temperature, a decomposition takes place; carbonic acid is discharged, and alcohol is formed; it remains in the liquid, however, and must be separated from it by distillation. It is a colorless, volatile liquid, of agreeable taste and odor, very inflammable, burning with a bluish flame, and mixing in all proportions with ether and water. Alcohol is capable of dissolving a great many substances, hence its extensive use as a solvent in many photographic operations. It is employed in the manufacture of varnishes; to dissolve pyrogallic acid; to prevent or arrest frilling; to extract water from wet gelatine plates, in order to effect rapid drying; and, in combination with ether, is a solvent for gun-cotton.

Alcohol, Methylated, often mentioned by English authors, is pure alcohol mixed with wood-spirits. On account of its disagreeable taste and odor, it is not fit to be used for the manufacture or adulteration of alcoholic beverages, and, therefore, is exempt from taxation within the British empire. When a formula prescribes methylated alcohol, Americans use the ordinary 95 deg. alcohol.

Alum is derived from the metal aluminium. Sulphate of aluminia will combine with the sulphates of potassa, soda and

ammonia, forming crystallizable double salts, the alums of commerce. Alum was used in former times to harden albumen films in the printing upon wood-engravers' blocks, but with the advent of the gelatine emulsion processes, it entered the laboratories of the photographers, to be there largely used. The potassium alum is used now to turn or harden gelatine films before or after fixing. It is also believed by many to remove the fixing-agent from plates or paper prints, but this has been proved by diligent researches not to be the case.

Alum, Chrome, is a double salt, isomorphous to alums, and consists of the sulphate of oxide of chromium with the sulphate of potassa or ammonia. It dissolves in water with a violet color, and is used with albumen or gelatine as a substratum for gelatine plates, or for hardening films in aggravated cases.

Ammonia, composed of nitrogen and hydrogen, is an extremely pungent and irrespirable gas; known to photographers in its aqueous solution; termed by them aqua ammonia, liquor ammonia, or forti (stronger) or caustic ammonia. It is prepared by heating chloride of ammonium in a retort with slacked lime. The gas evolved is absorbed by water in the receiver, which, when saturated, should show a specific gravity of 0.875. It must be kept in well-stoppered bottles, for when in contact with air, carbonic acid is absorbed and carbonate of ammonia formed. Liquor ammonia is used as an addition to the alkaline pyrogallic acid developer. Portrait photographers claim to be able to obtain with it better plasticity and detail than with either potassa or soda. Ammonia dissolves chloride of silver, and has been, therefore, recommended as a fixing-agent for prints. It is a test to distinguish the silver haloid from that of barium. After previous application of bichloride of mercury, it is used for intensifying gelatine negatives. With it we prepare ammonio-nitrate of silver for certain printing processes, and for Dr. Eder's gelatine emulsion. As a fuming agent for silvered albumen paper it is invaluable. With freshly-sensitized paper, the ammonia and free nitrate of silver adhering, forms a better sensitive compound than ordinary chloride of silver, and, with washed or permanent

paper, it acts as a chlorine absorber, when the reduction of metallic silver is effected by light, and thus acts beneficially to the printing process.

Ammonium, a hypothetical metallic radical, consists, like the ammonia, of nitrogen and hydrogen, and is capable of forming salts like the oxides of metals. It has not yet been obtained in its pure state, the nearest approach to it being an amalgam with mercury.

Ammonium Bichromate, made by neutralizing chromic acid with ammonia, is, on account of greater solubility than the corresponding potassium salt, which it resembles in appearance, much preferred to it in some of the mechanical printing processes.

Ammonium Bromide is made by neutralizing hydro-bromic acid with ammonia. It is a white, crystallizable salt, soluble in alcohol and water, and is used to restrain alkaline development, for the sensitizing of collodion and gelatine emulsions.

Ammonium Carbonate, a colorless, crystalline salt, is made, by sublimation, from chalk and chloride of ammonium. It has been used occasionally as an addition to the developer, in place of the aqua ammonia, and, by sprinkling its powder over the backs of printing-pads, it has been substituted for the fuming of sensitized albumen paper.

Ammonium Chloride, or sal-ammonia, is the oldest ammonium compound known. The ancients termed it sal-ammonia, for it was then prepared in the Syrian desert, near a temple of Jupiter Ammon, and made by subliming camel's dung. It is a white, translucent, fibrous salt, of pungent taste, very soluble in water, and is made now by neutralizing ammoniacal gas liquor with hydrochloric acid and subsequent rectification. It is principally used for salting albumenized and plain paper, and for the preparation of chloride of silver emulsions, when it converts the nitrate salt into chloride of silver.

Ammonium Iodide is a coarse, white, crystalline powder. It may be made by adding carbonate of ammonia to iodide of iron, but more easily by neutralizing hydro-iodic acid with ammonia. It is much used for making sensitive collodion, and is also added to gelatine emulsions.

Ammonium Oxalate has recently been recommended for the preparation of paper in the platinum printing process. It is made by neutralizing oxalic acid with ammonia.

Ammonium Sulphide, better known as hydrosulphate of ammonia, is used extensively by process workers to intensify black and white collodion negatives, after Dr. Eder's method, with nitrate of lead, or a previous intensification with bromide of copper. It is obtained by saturating ammonia with hydrosulphuric acid in excess, when it forms a yellow liquid of very disagreeable odor. Applied to the negative silver deposit, it forms the permanent sulphide of silver, and produces absolute opacity.

Ammonium Sulpho-cyanate, the rhodan-ammonium of the Germans, is a compound of sulpho-cyanic acid and ammonia; extremely poisonous; a fixing agent; and, in combination with gold chloride, is used for toning gelatine and chloride of silver prints (aristotypes).

Arrowroot is the starch obtained from the roots of *maran-tha arundinacea*, a plant growing in southern climes. That coming from Bermuda and Florida is considered to be the best. It is used for sizing plain printing paper and for making photographers' paste.

Asphaltum, or the bitumen of Judæa, is a mineral fossil. That coming from Asia Minor, owing to greater purity, is preferred by photographers. Asphaltum, of which only a part is sensitive to light, is used for copying negatives in line or stipple upon zinc plates, preparatory to etching. Previously the non-sensitive part is removed by digesting the whole in ether; the purified remnant is dissolved in benzole free from water; spread upon the plate; is then exposed to light under the negative. Asphaltum prints are distinguished by superior sharpness.

Bromine, a dark red, volatile fluid, of penetrating odor. In its chemical properties it resembles chlorine and iodine. All the combinations with metallic radicals are of the highest importance. It unites with them very energetically, and is able to displace oxygen from many of its combinations.

Bromine, in pure state, is occasionally added to positive

collodion (ferrotypes); was used extensively to sensitize Daguerreotype plates; and attempts have been made to unite it directly with silver for the bromide of silver gelatine emulsion.

Cadmium is a salt resembling tin in appearance and zinc in chemical properties. Its iodides and bromides were, at one time, used in the wet collodion process. Owing to their tendency to thicken, collodion process workers have now abandoned them.

Calcium, another metal of importance, occurs naturally in enormous deposits, as lime-stone, chalk, marble, gypsum, phosphates, and fluor spar. Its oxyd—lime—finds employment for various chemical and manufacturing purposes. In photography, it is little used. Lime-water, pure or with sugar, is sometimes added to alkaline developers.

Calcium Carbonate, or chalk, neutralizes the acidity of the perchloride of gold in various printing methods.

Calcium Chloride, for its great energy in attracting moisture, is used as a preservative for dry plates, sensitive paper, and as an exsiccator for various purposes. It has also been used in collodion, without showing, however, decided advantages over other chlorides.

Calcium Hypochlorite, the chloride of lime of commerce, is also added to certain gold toning-baths. It is supposed to give absolutely black tones. More extensively we employ it for making the hypo-chlorites of zinc, sodium and potassium, or hypo-eliminators. It should be employed only when perfectly dry, exhaling a strong odor of chlorine.

Chlorine, an elementary gas, of greenish-yellow color, irrespirable, and of penetrating odor, is made by heating 1 part of peroxide of manganese with 2 parts of hydro-chloric acid. The gas evolved is absorbed in cold water, and thus kept in solution. It must be kept in the dark, as, under the influence of light, hydro-chloric acid will form. Its affinity for hydrogen is very great, and is the only body which unites directly with gold and platinum. The combinations of chlorine with other elements, excepting oxygen and hydrogen, are termed chlorides, and are mostly soluble in water. Those with alkaline metals are used for the preparation of chloride of silver.

Collodion is a solution of pyroxyline or gun-cotton in ether-alcohol; has been, and is, to the present day, employed as a carrier of alkaline iodides, bromides and chlorides, with which corresponding silver salts are formed, when brought in contact with a solution of nitrate of silver.

Plain or normal collodion forms the substratum from which American film negatives are stripped, and it assists, in a similar manner, in enamelling prints. A modification (leather collodion) contains a few drops of castor oil to the ounce, and is preferred for stripping films.

Copper, in its pure, metallic state, is of a rose-red color, and can be obtained thus by electrolytic processes. Helio or photogravures are photographs etched upon copper-plates with acids or perchloride iron. In Obernetter's photo-copper-plate engravings, chloride of silver, into which the photographic silver deposit has been converted, affects, indirectly, etching. Photo-engraving blocks are multiplied in copper or electrotyped, and upon silvered copper-plates were made the first helio-graphic pictures, the Daguerreotypes.

The salts of this metal have found but limited application in photographic work. Copper nitrate or sulphate in the iron developer gives high intensity to a collodion negative; with the bromide salt, extra high intensity is gained after developing and fixing, and chloride of copper has been added to gelatine emulsions. Solutions of ammonio-sulphate of copper in interposed cells, are used in photo-micrographic work.

Cyanine, or chinoline blue, is a dye-stuff derived from alkaloids of the Peruvian bark. It is a greenish, crystalline powder; dissolves in alcohol and water with intense blue color. Being the most red-sensitive substance known, cyanine is much used in ortho-chromatic photography.

The compound dye, azaline, consists partly of cyanine.

Eosine, the potassium salt of tetra-bromo-fluorescein, is, owing to its yellow sensitiveness, also used in orthochromacy.

Erythrosine is extremely sensitive for general color-effects in reproducing colored objects, but mainly for green, yellow and orange; is a dye belonging to the group of eosines and the sodium salt of tetra-iodo-fluorescein.

Ether is a very volatile, colorless liquid, of agreeable odor; is prepared by distilling alcohol with sulphuric acid and rectifying the result over slacked lime. It dissolves fatty and essential oils, resins, alkaloids and the chlorides of gold, platinum, iron and uranium. With alcohol, it dissolves gun-cotton, resulting in collodion.

Ferric Salts are all yellow, red, or brown; the ferrous green, or bluish-green—the oxalates making exception, ferric-oxalate being green, and the ferrous of yellow color.

Ferrous-sulphate is used in large quantities to develop wet collodion plates. Ferrous-sulphate and ammonia, a more stable salt, is oftentimes substituted for it. In emulsion-plate photography ferrous-sulphate is only used for the preparation of the ferrous-oxalate.

Fluorine resembles iodine, bromine and chlorine in chemical properties. Fluoride of silver has been frequently recommended as an addition to sensitive substances, not giving, however, the expected result—higher sensitiveness.

Gelatine, or glue, is extracted from bones, tendons and other refuse matter of mature quadrupeds. Chondrine, a similar substance, made from cartilages or the bones of young animals, cannot be used for photographic purposes. All commercial gelatine contains more or less impurities, and must be purified before it can be used. This is done by soaking the gelatine for twenty-four hours in several changes of cold water, dissolving at a low temperature, and adding a trace of acetic acid. Then mix intimately the white of one egg with every pint of the solution, and heat rapidly till the albumen coagulates; filter; allow to cool, and press through coarse canvas into a vessel holding ice-water; change the water several times; collect the jelly, and spread it upon nets to dry. Such gelatine is sufficiently pure for all photographic purposes.

The more soluble the gelatine, the finer will be the film, but the more likely to frill. That used for emulsions should not lose its form by soaking in water.

Glycerine is a component of fats and fatty oils. It is a syrupy, colorless liquid, of sweet taste. It has a great affinity for water, with which it mixes in all proportions, and is

employed whenever any substance is to be kept moist for a length of time. For this reason, it is added to silver-baths, when collodion plates made sensitive in them have to be exposed for a very long time; but, as nitric acid decomposes glycerine speedily, such silver-baths must be acidulated with acetic acid.

Glycerine is added to the gelatine skins or solution for stripping films, in order to keep them flexible.

Gold occurs naturally in a tolerably pure state. To obtain it free from other metals, like silver or copper, it is precipitated from its solution in nitro-muriatic acid with protosulphate of iron, and the resulting brown powder (chemically-pure gold) is carefully washed, re-dissolved, evaporated, crystallized, or kept in solution. The

Gold Chloride, or ter-chloride, more proper, thus obtained, forms yellow-brown crystals; is very deliquescent; soluble in ether, alcohol and water, and is the basis for all photographic toning-baths for paper prints, and occasionally, also, for diapositives.

Gold, Chloride and Sodium, is a crystallizable double salt; as it does not contain free acid, and is not deliquescent, it can be much easier handled, and is, therefore, preferred by many.

Gold, Salt of (*Sel d'Or*), the hyposulphite of gold and sodium, is formed by adding a weak solution of chloride of gold to a weak solution of hyposulphite of soda, and evaporating. This salt was used for toning or gilding Daguerreotypes, and is occasionally employed for toning paper prints.

Iodine, like chlorine, which it closely resembles in chemical properties, is disseminated all over the earth, but is never found in large quantities. In the mineral kingdom it occurs but rarely, but is frequent in mineral springs and saline waters. It is made from kelp, the ashes of certain deep-sea fungi, and other marine plants, where it usually occurs united with sodium. It is a solid, of gray color and metallic lustre, resembling graphite, with which it is occasionally adulterated. At high temperatures, it becomes liquid, and is resolved into deep, violet vapors.

Iodine is one of the most important substances for the forming of light-sensitive bodies. With it Daguerre prepared his sensitive silver plates, and ever since it has been used to make sensitive papers, films or plates. It combines energetically with metallic and non-metallic bodies. In free state, it is used as an alcoholic solution or tincture, and sometimes in aqueous solution, when it is rendered soluble by the addition of potassium iodide. Tincture of iodine is added to freshly-prepared collodion to ripen it, and the operator removes silver stains by its use. The iodide of silver forming, being afterwards dissolved with hyposulphite of soda or cyanide of potassium.

Dilute tincture of iodine added to cold, boiled starch gives it an intensely blue color. This compound has been found to be an extremely sensitive reagent for hyposulphite of soda, and is, therefore, used to detect its presence in prints or negative films. A mere trace of hypo destroys the blue color with great energy.

Iron, in different combinations, is an important factor in many photographic processes.

Iron Chloride, per-chloride, or ferric-chloride, is in fragments, of a crystalline structure, of orange-yellow color, inodorous, and of strong styptic taste; is deliquescent, very soluble in water, alcohol and ether. With ferro-cyanide of potassium (the yellow prussiate of potassium), it forms an intense blue precipitate.

Per-chloride of iron is used in photography to arrest frilling of gelatine plates; with it, also, is removed green fog, by converting the negative deposit into chloride of silver, and redeveloping with ferrous-oxalate; for the preparation of ferric-oxalate and potassio-ferric oxalate which, in combination with hyposulphite of soda, is a fine reducer for over-developed negatives.

Iron Citrate and Ammonia is in garnet-red, translucent scales, having a slightly styptic taste; is deliquescent in air, and very soluble in water, forming a clear, ruby-colored solution. With ferri-cyanide of potassium (the red prussiate of potassium) and exposure to light, it gives us the cyanotype or blue print.

Iron Iodide, a crystalline substance of greenish-black color, was, at one time, used as an accelerator in the wet-collodion film.

Iron Oxalate, or ferrous-oxalate, is precipitated when a solution of oxalic acid, binoxalate, or neutral oxalate of potassium in excess is added to proto-sulphate of iron (ferrous-sulphate). It forms a pale yellow powder almost insoluble in water, but dissolves readily in a solution of neutral oxalate of potassium, forming with it a double salt (the common ferrous-oxalate developer). When an excess of sulphate of iron is added to the oxalate of potassium, it cannot be kept in solution and the yellow oxalate of iron precipitates. Such developer is unfit for use. Allowing ferrous-oxalate developer to stand for some time under the influence of air, it becomes oxidized, separating from the solution potassio-ferric oxalate in the form of beautiful green crystals. Partly oxidized developer may be profitably used as a restrainer, or restored to its original force by the addition of small particles of tartaric acid and exposure to direct sunlight.

Iron Proto-sulphate, sulphate of iron, or ferrous-sulphate, is in the form of transparent crystals, efflorescent; is of a pale bluish-green color, styptic taste and acid reaction. It is decomposed by tannic, gallic, and pyrogallic acid, forming a bluish-black compound (ink). When effloresceing it loses a part of its water of crystallization, and is entirely deprived of it by exsiccation. In such states the iron salt should not be employed for photographic purposes; neither is it fit to be used when, after long standing, a brown or red crust covers the crystals. That denotes a higher oxidation, which to prevent in our sulphate of iron solutions, we add a trace of sulphuric acid to them.

Kaolin, or porcelain clay, consists for the most part of silicate of aluminia.

It is used for decolorizing the silver sensitizing bath.

Lead. Not many of the salts of this metal have been entered upon the list of photographic chemicals.

Lead Acetate, at one time considered to be a perfect hypo-eliminator, is now done almost entirely away with, its deleterious effects having been conclusively shown.

Lead Nitrate was recommended by Dr. Eder as an intensifier for black and white collodion negatives, and is now largely employed as such. When nitrate of lead and ferri-cyanide of potassium are acting upon a negative deposit, the ferri-cyanide is deoxidized to ferro-cyanide, forming, with the lead, ferro-cyanide of lead, an insoluble compound, which is subsequently blackened with hydro-sulphate of ammonia.

Litmus is a coloring matter derived from *r'ocella tinctoria*, and other lichens. It is used as a test for acids and alkalines, and is employed either in tincture or bibulous paper colored with it. When acidity is present the blue color turns red, and is restored again to blue by alkaline solutions.

Magnesium is a white malleable metal which burns with a a brilliant flame of highly actinic power, furnishing to the photographer a very useful artificial light. Since, with the presence of oxygen, the flame becomes still more actinic, the metal reduced to a fine powder is mixed with purveyors of oxygen and then ignited. Instantaneous exposures can thus be made in total darkness.

Magnesium Chloride is sometimes used for the salting of paper, and the iodide was at one time considered a most excellent sensitizer for negative collodion.

Magnesium Sulphate, or Epsom salts, a white crystalline salt, of bitter taste, is an excellent anti-frill, because it has the property of hardening gelatine and similar substances.

Mercury is the only liquid metal in existence. It is volatile even at such moderate temperatures as 70–80 deg. F. By means of mercurial vapors the Daguerrean plates were developed.

Mercury Bichloride, mercuric chloride, or corrosive sublimate is a colorless, crystalline, semi-transparent mass, of metallic taste, and is very poisonous. It is soluble in water, alcohol, and ether.

When a photographic deposit is washed with a solution of mercuric chloride, a white double chloride of mercury and silver will form, which is insoluble in water. Upon this action are based most processes of intensifying; the white image being afterwards blackened with ammonia or sulphite of

sodium. Positives on japanned tin-plates are whitened with the mercuric chloride (alabastrines) and the silver is bleached from drawings to serve the photo-engraver. Paper photographs bleached out with mercury can be restored again by hypo-sulphite of soda or ammonia ("magic" photographs). With mercuric chlorides we remove silver stains from our garments and fingers, or when in very dilute solution restore yellow prints to their original whiteness.

Mercury Nitrate in solution is a test for hypo, with which it forms a brown-black precipitate.

Platinum is a precious metal of dull, grayish-white color, of less lustre than silver, not affected by mineral acids. Like gold, it combines with chlorine, and to effect its solution aqua regia, or nitro-muriatic acid, alone can be used. The resulting platinum chloride is a dark-brown solution.

Platinum Potassio-chloride, a double salt of bright yellow color, is used in the different platinum printing processes.

Potassium is the metallic radical of all the salts bearing its name. Its oxyd,

Potassium Hydroxyd, or caustic potash, is a deliquescent and easily soluble substance, occasionally used as an accelerator in developing gelatine emulsion plates.

Potassium Bichromate, orange-red, anhydrous, prismatic crystals, soluble in ten parts of water, not soluble in alcohol, of strong acid reaction, is very poisonous. All chromates are indirectly sensitive to light. Their behavior towards light when mixed with organic matter, gelatine, or albumen, is of the highest interest, for upon it are based most photo-mechanical printing processes. Light changes the chromates and oxydizes the organic matter, making it insoluble in water.

Potassium Bromide. This salt forms white, cubical crystals which are very soluble in water, but sparingly so in alcohol. For the preparation of bromide of silver, in the emulsion process, it is better adapted than any of the other bromides. For that purpose it is important to use it in a state of absolute purity.

The presence of iodide can be detected by the yellow color of the precipitate, when a trace of nitrate of silver solution is

added to a solution of the bromide. Iodide is denoted when the precipitate has a yellow color. Bromide of potassium is used extensively to form bromide of silver in emulsions for sensitizing collodion, and is the most popular restrainer in developing emulsion-plates.

Potassium Carbonate is usually made from the crude potash. A very pure article, sufficient for developing purposes, is prepared by incinerating cream of tartar—bitartrate of potassium — lixiviating the ashes and evaporation. It is a white, deliquescent salt, very soluble in water, has a strong alkaline reaction and effervesces with acids. With carbonate of potassium are prepared the most energetic developers for instantaneous exposures.

Potassium Bicarbonate. The ordinary carbonate united with another equivalent of carbonic acid. Saleratus is an impure bicarbonate. It is soluble in water but not in alcohol. It is used to neutralize acid solutions and to soften gelatine in some of the photo-mechanical processes.

Potassium Chlorate has of late found photographic employment in furnishing oxygen to the burning magnesium of its flash-light compounds; but, on account of its explosive properties, the salt has been almost entirely abandoned. It has no other use in photography.

Potassium Chloride closely resembles common salt (sodium chloride) in appearance, assuming the cubic form of crystallization. It is but rarely used.

Potassium Cyanide. The commercial article comes in white, opaque, amorphous masses, of sharp, alkaline, bitter taste, and alkaline reaction; exhales the odor of hydro-cyanic acid, and is very poisonous. For collodion plates it was much used for fixing purposes. It might be used for gelatine plates, also, for the same purpose; but, it being adulterated very frequently with hydrate and carbonate of potassium, these salts would weaken the gelatine film very much. Except to remove with it silver stains from hands and fingers, the article is but rarely used since gelatine plates have superseded the collodion.

Potassium Sulpho-cyanide, analagous to the ammonium salt, is white and crystallizable, resembling the taste of nitre; soluble

in water and alcohol, and very poisonous. It has been employed as a fixing-agent, and, in combination with the chloride of gold, in toning-baths.

Potassium Ferri-cyanide, known as red prussiate of potash, is obtained by passing chlorine gas through a solution of potassium ferro-cyanide. It forms beautiful red crystals, which are converted by light into the yellow potassium ferro-cyanide; the solution produces a dark-blue precipitate with ferrous salts, and a brown color with ferric salts.

It is used in the cyanotype process. Potassium ferri-cyanide, being sensitive to light, its solutions should be kept in the dark. If the solution has assumed a greenish or blue color, it is unfit for use. With hyposulphite of soda, it forms Farmer's solution for the reduction of intensity, and, with nitrate of uranium, Selle's intensifier, recently used for toning bromide prints or transparencies on gelatine plates.

Potassium Ferro-cyanide, or yellow prussiate, is obtained by heating refuse animal matter with iron filings and potassium carbonate. It is soluble in water, but not in alcohol. It forms very beautiful yellow crystals. With ferrous salts it gives a pale, blue precipitate, while, with ferric salts, a precipitate of Prussian blue ensues. Because of this property, it is also used in some of the blue print methods, especially in one by which positives from positives are obtained.

Potassium Hypochlorite, in solution, is the well-known *eau de javelle*, which is an excellent hypo-eliminator.

Potassium Iodide is prepared by adding iodine to a solution of hydrate of potassium, and, after evaporating, by gently heating the solution to decompose the iodate formed simultaneously with the iodide. It forms white, cubical crystals, which are very soluble in water and alcohol. With nitrate of silver the solution produces a bright, yellow precipitate of iodide of silver.

Iodide of potassium is extensively used for sensitizing collodion, and is now invariably added to bromide emulsions to increase sensitiveness.

Potassium Nitrate, saltpetre or nitre, a white salt, of sharp, cooling, bitterish taste; crystallizes in long, striated, six-sided

prisms, permanent in air. It is devoid of water of crystallization; soluble in water, but not in alcohol. In combination with sulphuric acid, photographers use it in the making of gun-cotton; as an addition to the developer for collodion positives (Spiller & Crooker); as a restrainer in alkaline development.

Potassium Oxalate. There are three combinations of potassium with oxalic acid—the neutral salt, the bin-oxalate, and the quadroxalate—of which the neutral salt alone concerns the photographer. It is colorless and efflorescent, of bitter taste, and poisonous.

The neutral salt of commerce reacts more or less alkaline, in which state it will, in the oxalate developer, produce hard and glassy negatives. Hence oxalic acid is added to its solution in quantities sufficient to slightly redden litmus paper. It should, also, be free from chlorides.

Potassium Permanganate forms crystals of dark purple color; its solutions are red. Manganates and permanganates are decomposed by organic matter acting upon them as oxidizers. Hence the salt is used to rectify silver baths overcharged with organic substances. Permanganate solution should be added as long as the roseate color remains. Sunning the bath afterwards is advisable. An excess of the salt makes the solution alkaline, which requires after-acidulation.

Potassium Silicate, which is ordinary glass, can be made in a soluble modification when silica is melted with twice its weight of carbonate of potassium or sodium, and the product treated with water, which dissolves the greater part. This preparation, known as water-glass or soluble glass, is used as a substratum for gelatine emulsion plates and in making Lichtdruck plates.

Potassium Sulphate is a white, hard, semi-transparent salt, soluble in water, but not in alcohol; is claimed to give collodion positives a white metallic lustre when added to the iron developer.

Potassium Sulphide, sulphuret, hepar sulphuris, or liver of sulphur, is the substance with which photographers precipitate silver from waste solutions. It is a solid, amorphous mass of

liver-brown color, and very soluble in water. The solutions, when exposed to air, oxidize, form sulphate of potassium, and separate sulphur. When dry, it is inodorous; in the moist state, its odor is very disagreeable. The sulphide is also used to intensify collodion negatives.

Pyroxyline, or gun-cotton, dissolved in ether-alcohol, constitutes the photographic collodion. It is prepared by subjecting white cotton, free from greasy matter, to the action of nitrate of potassium and sulphuric acid, or a mixture of sulphuric and nitric acid, washing till all acid is removed, and then spontaneously drying. It should be perfectly white, without exhaling the odor of nitrous acid, and should be soluble without sediment. Gun-cotton of long fibre, producing a crackling noise when being pulled out, is generally preferred for negative collodion; when in a powdery state, it is asserted to be better adapted for positives (ferrotypes).

Sal-soda is of high value in the photographers' laboratory, as a medium for the cleaning of glass plates, preparatory to coating them with sensitive substances.

Silver is found naturally in large quantities—occasionally in a very pure state. In combination with chlorine, bromine, or iodine, it is the most important factor in all photographic operations, for it forms the photographic image, when reduced to metallic silver by a variety of processes.

Silver Acetate. When the silver bath, in the wet collodion process, is acidulated to a great extent with acetic acid, very small crystals of the nearly insoluble acetate of silver will separate, settle upon the sides of the bath-dish; even upon the surface of the collodion film to be sensitized. These crystals interfere greatly with the operation to be performed, and their presence makes the bath useless.

Silver Bromide, an insoluble haloid, of grayish-white color, is formed when a solution of an alkaline bromide is added to a solution of nitrate of silver. Bromide of silver is known to exist in five modifications of different sensitiveness and aggregation. That employed in photography is easily blackened by light, easily soluble in cyanide of potassium and hyposulphite of sodium, but sparingly so in ammonia. Silver bromide is

the active principal in our negative emulsions; the addition of a certain percentage of silver iodides increases their sensitiveness. The various kinds of bromide of silver paper have superseded all other positive enlarging processes, and, to some extent, contact printing upon other sensitive paper also.

Silver Carbonate. When, to a solution of nitrate of silver, carbonate of soda is added, a yellowish-white precipitate will deposit, which is carbonate of silver. This precipitate, allowed to settle, and after being well washed, when added to a silver-bath, is the best means to keep it in a constant state of neutrality. Acidity formed in a printing-bath, after repeated use, will be neutralized by keeping some of the solution in the stock bottle.

Carbonate of silver, thrown down from old solutions or wastes, is converted again into chemically-pure nitrate by dissolving it carefully in dilute nitric acid.

Silver Chloride is prepared similarly to the bromide by bringing a solution of nitrate of silver in contact with an alkaline chloride. *Horn Silver*, as this preparation was called in ancient times, gave the first impulse to the researches on the action of light. Chlorine gas is liberated, when it is exposed to light, leaving a residue of metallic silver intimately mixed with undeveloped chloride. It is soluble in hyposulphite of soda, ammonia, cyanide of potassium, and more or less in a great many soluble chlorides. The main substance upon which all photographic printing depends is chloride of silver, for when salted, plain, or albumenized paper is floated upon a nitrate of silver solution, chloride of silver is formed.

Chloride of silver emulsions are popular. With collodion, as a carrier for the sensitive salt, are made aristotypes; with gelatine, it is used in the various opal, transparency, and other processes.

Silver Hyposulphite and Sodium, argento-sodium hyposulphite, is a double salt, formed during the fixing of a plate or print. Being sensitive to light, it is advisable to conduct the fixing operation in a dark room, or in subdued light. At a certain point of the fixing this salt is formed, but it is dissolved again in an excess of the hyposulphite of soda. If,

before its dissolution, the plate or print is exposed to light, sulphides form with the separation of sulphur, and the film turns yellow. Such stains it is impossible to remove. To obviate entirely such occurrences, it is commendable to employ in all fixing operations a second freshly-prepared hypo bath. The injurious double salt being soluble in hypo, a fresh fixing solution, not contaminated with dissolved silver, is the best safeguard against fading or yellowing.

Silver Iodide, resembling the two other silver haloids, is of a decidedly yellow color. With iodide of silver the Daguerreotype was made. It was the sensitive medium of the Talbotype, and mainly that of the American (Whipple's) negative albumen process. Collodion was sensitized solely with it, until bromide became its associate. When in the preparation of iodide of silver an excess of nitrate of silver is present, the precipitate is of a decided yellow color and highly sensitive, but when the alkaline iodide prevails, the resulting deposit is of a pale color and absolutely non-sensitive. It is but sparingly soluble in ammonia, but cyanide of potassium and hyposulphite of soda dissolve the iodide with great energy. The addition of a small percentage of iodide of silver to the bromide emulsion increases sensitiveness and gives brilliancy to the negatives; passing that point, the negative becomes feeble, and the plates fix slowly and with difficulty. Pure iodide of silver gives the best results in the "black and white" collodion copying processes.

Silver Nitrate is prepared by dissolving pure metallic silver in dilute nitric acid, evaporating the solution to crystallization point, and crystallizing the salt. If evaporation is carried on so far that the mass in the bowl begins to flow like an oil, and is then poured into forms, or upon a cold marble slab, we have *fused* nitrate of silver. For photographic use the crystallized salt is preferable; by long-continued heating the nitrate is partially reduced to nitrite, injurious, at least, in the collodion process.

Nitrate of silver comes in colorless, transparent crystals, sometimes of considerable size, when they have a metallic ring. It is soluble in its own weight of water and in four parts of

alcohol. When its solutions are precipitated with a soluble chloride or hydrochloric acid, the supernatant liquid should not leave a residue after evaporation, and the precipitate be perfectly soluble in ammonia. That is a proof of the purity of the salt.

From the nitrate of silver are derived all the silver haloids used in photography.

Ammonia causes a precipitate in nitrate of silver solutions, but the precipitate re-dissolves in an excess of the precipitant. Ammonio-nitrate of silver thus formed is used in Dr. Eder's gelatine emulsion and various printing methods on plain or albumenized paper. Fuming of sensitized paper is based upon the reaction of ammonia.

Sodium, a silver-white metal, oxidizing rapidly in air, is the radical of all the salts bearing its name. It is found in enormous quantities, and is distributed all over the world; in solid crystalline masses, in the waters of the ocean, and many saline springs.

The hydrated oxide is occasionally used to accelerate alkaline developing.

Sodium Acetate is a white salt, crystallizing in long, striated prisms, of sharp, bitterish taste. It is soluble in water and of neutral reaction. As an addition to the gold toning-bath, neutralized with bicarbonate of soda, it is invaluable for the producing of the much-desired proper tone of albumenized prints.

Sodium Borate, *Bi-borate*, or *Borax*, exists native in several localities of America and Europe. It is a white, crystalline salt, reacts alkaline, and possesses a bitter, alkaline taste. On account of its alkalinity it is employed in many toning methods, where it is claimed to give black shades.

Borax is a strong restrainer in the alkaline development, and is, furthermore, an aid in dissolving shellac in water. Such shellac solutions are occasionally employed as varnishes for gelatine negatives, but their principal use is to give gloss to Lichtdrucks and photo-lithographs.

Sodium Bromide and *Iodide* are but rarely used in photography at present.

Sodium Carbonate. The crystals of this extensively-used and well-known salt (sal-soda) dissolve rapidly in water, are of disagreeable taste and strong alkaline reaction. We use this salt as an accelerator to the developing of emulsion plates with pyrogallol. Exsiccated—that is, deprived of its water of crystallization—its strength is about doubled; hence half the quantity only should be taken when a formula prescribes the crystallized salt.

Sodium Bicarbonate, a preparation similar to the corresponding potassium salt, is milder in taste and does not act as forcibly as the simple carbonate. Its use to neutralize the acidity of the chloride of gold, for the purpose of toning, is quite universal.

Sodium Chloride, the common table salt, occurs in enormous quantities all over the world. For the salting of printing papers it is but rarely used, the corresponding ammonium chloride being generally preferred.

Sodium Citrate, a white, crystalline salt, of saline taste and easily soluble in water, is a most energetic restrainer. Its action, when employed in a 10 per cent. solution, is so extremely forcible that plates believed to be hopelessly overexposed will result in serviceable negatives by its use.

Sodium Hypochlorite, or Labarraque's solution is, like the potassium hypochlorite, used to destroy chemically the last traces of hyposulphite of soda in print or plate.

Sodium Hyposulphite, large, colorless, transparent crystals, of saline taste and neutral reaction; is very soluble in water, but not in alcchol. Its solution dissolves the haloids of silver, and it is, therefore, of the highest value in all photographic operations, for it dissolves from plate, film or paper all those parts of the silver salt upon which light and the developer have not acted; it "fixes" them, as it improperly is called. The hyposulphite of soda of commerce is pure and neutral enough to use for all our purposes; the addition of alkalis to its solution is of no use whatever, excepting, perhaps, in a few particular cases. Sulphuric, muriatic or other strong acids added to the solution separates sulphur and causes sulphurous acid to evolve. The salt is thereby distinguished from the

sulphite, which, with acid, evolves likewise sulphurous acid but without precipitating sulphur.

Hyposulphite dissolves iodine and destroys the blue color of iodide of starch. Hence iodide of starch is a valuable test for hypo.

This salt, a valuable assistant, is also a great enemy to the photographer when improperly used. It is easily decomposed, resulting in sulphuration.

In extremely weak solutions it accelerates the ferrous-oxalate development. If too strong, a lustrous deposit of metallic silver will result.

Sodium Nitrate, cubic or Chili saltpetre, called so from its crystalline form and native source, is but rarely employed. Owing to its great ease of crystallization it has been refused as a nitrifier in the making of gun-cotton.

Sodium Silicate, soluble sodium glass, like the analagous potassium silicate, is used similarly as a substratum for emulsion films.

Sodium Sulphite is in the form of white, transparent crystals, very soluble in water. It is deliquescent; when exposed to air it attracts oxygen, forming itself into sulphate. Sulphite is a preserver of pyrogallol, sulphate is not. Hence, when in pure state, it is employed extensively for the purpose stated. If, however, the salt is not what it pretends to be, it becomes useless.

The granulated or exsiccated sulphite is safer to employ, because it is more constant than the crystallized salt; still, it must be remembered that it loses about 50 per cent. of its weight by exsiccation, and, if a formula calls for a certain amount of the crystallized salt, half the quantity of the granulated will be approximately correct. Many virtues and faults have been ascribed to the sulphite, but, besides its pyro-preserving properties, no other advantages have been distinctly proved.

Sodium Tungstate, a rare salt, of neutral reaction, is said to give positive black tones when used with the gold toning-bath.

Strontium is a metal resembling calcium in appearance and chemical properties.

Its nitrate is used in the preparation of chloride of silver, collodion emulsions, and similar processes.

Uranium Nitrate is produced by dissolving the metal uranium, or either of its oxides, in nitric acid. The salt forms bright, yellow crystals with a greenish cast; is very soluble in water and alcohol. In combination with ferri-cyanide of potassium it is used as a mechanical intensifier for gelatine and collodion plates, positives and negatives alike. Its action is to give the plate a non-actinic, brown color, by which printing is retarded. A very dilute solution of cyanide of potassium removes the color without injury to the silver deposit.

With nitrate of uranium a great variety of tones on paper or glass can be made. It is sensitive to light.

Varnish. Most photographic varnishes consist of alcoholic solutions of shellac, resins, or resinous gums. Gelatine, being extremely hygroscopic, all moisture must be expelled from its films before varnish is applied. When moisture is present the shellac will precipitate upon the film in the form of white, granular deposits. A wash with alcohol will remove these deposits, after which varnishing can be accomplished.

Water is a transparent liquid without color, taste, or odor, consisting of oxygen and hydrogen. By reason of its great dissolving power, it is always more or less contaminated with foreign matter, carbonic acid, carbonates, chlorides, ammonia, and organic substances. Carbonic acid and other gases absorbed in water cause blisters upon albumenized paper; carbonate of lime in water forms a precipitate with the oxalate of potassium; and chlorides precipitate silver. For most photographic operations, purified or distilled water is absolutely necessary. Ordinary water boiled for some time and allowed to cool is free from calcareous matter, and absorbed gases are expelled, hence it is comparatively pure, and may be employed for photographic use.

Zinc is a bluish-white metal, brittle, and of crystalline structure. It is added, occasionally, when reduced to a fine powder, to the magnesium flash-light compounds. It burns with a bluish-green, quite actinic flame, and may be used profitably in this connection when long exposures are required. With

polished zinc plates or rods, it precipitates metallic silver from waste solutions by mere immersion, and in photo-mechanical printing methods zinc plays a highly important part. Upon finely polished zinc plates, coated with asphaltum or bichromatized organic substances, are printed the photographs preparatory to etching them into high reliefs for the ordinary typographic press.

Zinc Bromide is occasionally added to sensitive collodion.

Zinc Hypochlorite, prepared by decomposing chloride of lime with zinc sulphate, is a perfect and absolutely safe hypo-eliminator, because the salts resulting from the contact of hyposulphite of soda with hypochlorite of zinc are very soluble in water and harmless to the photographic silver deposit.

ENGLISH WEIGHTS AND MEASURES.

APOTHECARIES' WEIGHT.

SOLID MEASURE.

20 Grains	= 1 Scruple	= 20 Grains.
3 Scruples	= 1 Dram	= 60 "
8 Drams	= 1 Ounce	= 480 "
12 Ounces	= 1 Pound	= 5760 "

FLUID.

60 Minims	= 1 Fluid Dram.
8 Drams	= 1 Ounce.
20 Ounces	= 1 Pint.
8 Pints	= 1 Gallon.

The above weights are those usually adopted in formulæ.

All Chemicals are usually sold by

AVOIRDUPOIS WEIGHT.

$27\frac{11}{32}$ Grains	= 1 Dram	= $27\frac{11}{32}$ Grains.
16 Drams	= 1 Ounce	= $437\frac{1}{2}$ "
16 Ounces	= 1 Pound	= 7000 "

Precious Metals are usually sold by

TROY WEIGHT.

24 Grains	= 1 Pennyweight	= 24 Grains.
20 Pennyweights	= 1 Ounce	= 480 "
12 Ounces	= 1 Pound	= 5760 "

NOTE.—An ounce of metallic silver contains 480 grains, but an ounce of nitrate of silver contains only $437\frac{1}{2}$ grains.

THE METRIC SYSTEM OF WEIGHTS AND MEASURES.

The meter is a measure of length equal to 39.370 English inches, or 39.368 American inches, a standard of linear measure supposed to be the ten-millionth part of the distance from the equator to the north pole, as ascertained by actual measurement of an arc of the meridian.

This system, formed on the meter as the unit of length, has four other leading units, all connected with and dependent upon this. Hence, we have:

1. The meter, which is the unit of measures of length.

2. The are, which is the unit of surface, and is the square of the meters.

3. The litre, which is the unit of measures of capacity, and is the cube of a tenth part of the meter.

4. The stere, which is the unit of measures of solidity, having the capacity of a cubic meter.

5. The gram, which is the unit of measures of weight, and is the weight of that quantity of distilled water at its maximum density, fills the cube of a hundredth part of the meter.

Each unit has its decimal multiples and submultiples, that is weights and measures ten times larger, or ten times smaller, than the principal units. The prefixes denoting multiples are derived from the Greek and are: deka, ten; hecto, hundred; kilo, thousand, and myria, ten thousand. Those denoting submultiples are taken from the Latin, and are deci, ten; centi, hundred (like in centigram or centimeter) and milli, thousand.

The metric system has been adopted by many nations, the English excepted. In America its use has been made optional, but is legalized by Congress. All photographic formulæ received from the continent of Europe express values and quantities with metrical weights and measures. To utilize them direct without translating into the expressions of the English system, the student is advised to procure gram weights and cubic centimeter graduates, and substitute them for those denoting quantities according to the old plan.

As an assistant to those who cannot acquire these aids, we annex tables taken from the "British Almanac of Photography," which convert grams and cubic centimeters into English grains, drams, and ounces, sufficiently correct for practical purposes.

FRENCH FLUID MEASURES.

THE cubic centimetre, usually represented by "c.c.," is the unit of the French measurement for liquids. It contains nearly seventeen minims of water; in reality, it contains 16·896 minims. The weight of this quantity of water is one gram. Hence it will be seen that the cubic centimeter and the gram bear to each other the same relation as our dram for solids and the dram for fluids, or as the minim and the grain. The following table will prove to be sufficiently accurate for photographic purposes:

1	cubic centimetre	=	17	minims (as near as possible).						
2	cubic centimetres	=	34	"						
3	"	=	51	"						
4	"	=	68	"	or	1	dram	8	minims.	
5	"	=	85	"	"	1	"	25	"	
6	"	=	102	"	"	1	"	42	"	
7	"	=	119	"	"	1	"	59	"	
8	"	=	136	"	"	2	drams	16	"	
9	"	=	153	"	"	2	"	33	"	
10	"	=	170	"	"	2	"	50	"	
20	"	=	340	"	"	5	"	40	"	
30	"	=	510	"	"	1	ounce	0	dram	30 minims.
40	"	=	680	"	"	1	"	3	drams	20 "
50	"	=	850	"	"	1	"	6	"	10 "
60	"	=	1020	"	"	2	ounces	1	"	0 "
70	"	=	1190	"	"	2	"	3	"	50 "
80	"	=	1360	"	"	2	"	6	"	40 "
90	"	=	1530	"	"	3	"	1	"	30 "
100	"	=	1700	"	"	3	"	4	"	20 "
1000	"	=	1 litre = 34 fl. ounces nearly, or $2\frac{1}{8}$ pints.							

THE CONVERSION OF FRENCH INTO ENGLISH WEIGHT.

ALTHOUGH a gram is equal to 15·4346 grains, the decimal is one which can never be used by photographers; hence in the following table it is assumed to be $15\frac{2}{5}$ grains, which is the nearest approach that can be made to *practical* accuracy:

1	gram	=	$15\frac{2}{5}$	grains.					
2	grams	=	$30\frac{4}{5}$	"					
3	"	=	$46\frac{1}{5}$	"					
4	"	=	$61\frac{3}{5}$	"	.....	or	1 dram	$1\frac{2}{5}$	grain.
5	"	=	77	"	.....	"	1 "	17	grains.
6	"	=	$92\frac{2}{5}$	"	.....	"	1 "	$32\frac{2}{5}$	"
7	"	=	$107\frac{4}{5}$	"	.....	"	1 "	$47\frac{4}{5}$	"
8	"	=	$123\frac{1}{5}$	"	.....	"	2 drams	$31\frac{1}{5}$	"
9	"	=	$138\frac{3}{5}$	"	.....	"	2 "	$18\frac{3}{5}$	"
10	"	=	154	"	.....	"	2 "	34	"
11	"	=	$169\frac{2}{5}$	"	.....	"	2 "	$49\frac{2}{5}$	"
12	"	=	$184\frac{4}{5}$	"	.....	"	3 "	$4\frac{4}{5}$	"
13	"	=	$200\frac{1}{5}$	"	.....	"	3 "	$20\frac{1}{5}$	"
14	"	=	$215\frac{3}{5}$	"	.....	"	3 "	$35\frac{3}{5}$	"
15	"	=	231	"	.....	"	3 "	51	"
16	"	=	$246\frac{2}{5}$	"	.....	"	4 "	$6\frac{2}{5}$	"
17	"	=	$261\frac{4}{5}$	"	.....	"	4 "	$21\frac{4}{5}$	"
18	"	=	$277\frac{1}{5}$	"	.....	"	4 "	$37\frac{1}{5}$	"
19	"	=	$292\frac{3}{5}$	"	.....	"	4 "	$52\frac{3}{5}$	"
20	"	=	308	"	.....	"	5 "	8	"
30	"	=	462	"	.....	"	7 "	42	"
40	"	=	616	"	.....	"	10 "	16	"
50	"	=	770	"	.....	"	12 "	50	"
60	"	=	924	"	.....	"	15 "	24	"
70	"	=	1078	"	.....	"	17 "	58	"
80	"	=	1232	"	.....	"	20 "	32	"
90	"	=	1386	"	.....	"	23 "	6	"
100	"	=	1540	"	.....	"	25 "	40	"
1000	"	=	1 kilogram = 32 oz., 3 dr., 40 gr.						

PROF. BURTON'S TABLE OF COMPARATIVE EXPOSURES.

Apertures Calculated on the Standard System of the Photographic Society.	Sea and Sky.	Open Landscape.	Landscape with heavy foliage in foreground.	Under Trees, up to		Fairly Lighted Interiors.		Badly Lighted Interiors, up to		Portraits in bright diffused Light out of doors.	Portraits in good Studio Light.		Portraits in Ordinary Room.	
				mins.	secs.	mins.	secs.	hrs.	mins.		mins.	secs.	mins.	secs.
No. 1, or $\frac{f}{4}$	$\frac{1}{160}$ sec.	$\frac{1}{50}$ sec.	$\frac{1}{8}$ sec.	0	10	0	10	0	2	$\frac{1}{6}$ sec.	0	1	0	4
No. 2, or $\frac{f}{5.657}$	$\frac{1}{80}$ sec.	$\frac{1}{25}$ sec.	$\frac{1}{4}$ sec.	0	20	0	20	0	4	$\frac{1}{3}$ sec.	0	2	0	8
No. 4, or $\frac{f}{8}$	$\frac{1}{40}$ sec.	$\frac{1}{12}$ sec.	$\frac{1}{2}$ sec.	0	40	0	40	0	8	$\frac{2}{3}$ sec.	0	4	0	16
No. 8, or $\frac{f}{11.314}$	$\frac{1}{20}$ sec.	$\frac{1}{6}$ sec.	1 sec.	1	20	1	20	0	16	$1\frac{1}{3}$ sec.	0	8	0	32
No. 16, or $\frac{f}{16}$	$\frac{1}{10}$ sec.	$\frac{1}{3}$ sec.	2 secs.	2	40	2	40	0	32	$2\frac{2}{3}$ secs.	0	16	1	4
No. 32, or $\frac{f}{22.627}$	$\frac{1}{5}$ sec.	$\frac{2}{3}$ sec.	4 secs.	5	20	5	20	1	4	$5\frac{1}{3}$ secs.	0	32	2	8
No. 64, or $\frac{f}{32}$	$\frac{2}{5}$ sec.	$1\frac{1}{3}$ sec.	8 secs.	10	40	10	40	2	8	$10\frac{2}{3}$ secs.	1	4	4	16
No. 128, or $\frac{f}{45.255}$	$\frac{4}{5}$ sec.	$2\frac{2}{3}$ secs.	16 secs.	21	20	21	20	4	16	21 secs.	2	8	8	32
No. 256, or $\frac{f}{64}$	$1\frac{3}{5}$ sec.	$5\frac{1}{3}$ secs.	32 secs.	42	40	42	40	8	32	42 secs.	4	16	17	4

ELSDEN'S TABLE OF POISONS AND ANTIDOTES.

	Poisons.	Remarks.	Characteristic Symptoms.	Antidote.
Caustic Vegetable Alkalies.	Oxalic Acid. including Potassium Oxalate.	1 dram is the smallest fatal dose known.	Hot, burning sensation in throat and stomach; vomiting, cramps, and numbness.	Chalk, whiting or magnesia, suspended in water. Plaster or mortar can be used in emergency.
	Ammonia. Potash. Soda.	Vapor of ammonia may cause inflammation of the lungs.	Swelling of tongue, mouth, and fauces; often followed by stricture of the œsophagus.	Vinegar and water.
Metallic Salts.	Mercuric Chloride.	3 grains the smallest known fatal dose.	Acrid, metallic taste, constriction and burning in throat and stomach, followed by nausea and vomiting.	White and yolk of raw eggs with milk. In emergency, flour paste may be used.
	Acetate of Lead.	The sub-acetate is still more poisonous.	Constriction in the throat and at pit of stomach; crampy pains and stiffness of abdomen; blue line round the gums.	Sulphates of soda or magnesia. Emetic of sulphate of zinc.
	Cyanide of Potassium.	*a*. Taken internally, 3 grs. fatal.	Insensibility, slow, gasping respiration, dilated pupils, and spasmodic closure of the jaws.	No certain remedy; cold affusion over the head and neck most efficacious.
		b. Applied to wounds and abrasures of the skin.	Smarting sensation.	Sulphate of iron should be applied immediately.
	Bichromate of Potassium	*a*. Taken internally.	Irritant pain in stomach, and vomiting.	Emetics and magnesia, or chalk.
		b. Applied to slight abrasions of the skin.	Produces troublesome sores and ulcers.	
	Nitrate of Silver.		Powerful irritant.	Common salt to be given immediately, followed by emetics.
Concentrated Mineral Acids.	Nitric Acid.	2 drams have been fatal. Inhalation of the fumes has also been fatal.	Corrosion of windpipe and violent inflammation.	Bicarbonate of soda, or carbonate of magnesia or chalk, plaster of the apartment beaten up in water.
	Hydrochloric Acid.	½ ounce has caused death.		
	Sulphuric Acid.	1 dram has been fatal.		
	Acetic Acid, concentrated, has as powerful an effect as the mineral acids.			
	Iodine.	Variable in its action; 3 grains have been fatal.	Acrid taste, tightness about the throat, vomiting.	Vomiting should be encouraged, and gruel, arrowroot and starch given freely.
	Ether.	When inhaled.	Effects similar to chloroform.	Cold affusion and artificial respiration.
	Pyrogallol.	2 grains sufficient to kill a dog.	Resemble phosphorus poisoning.	No certain remedy. Speedy emetic desirable.

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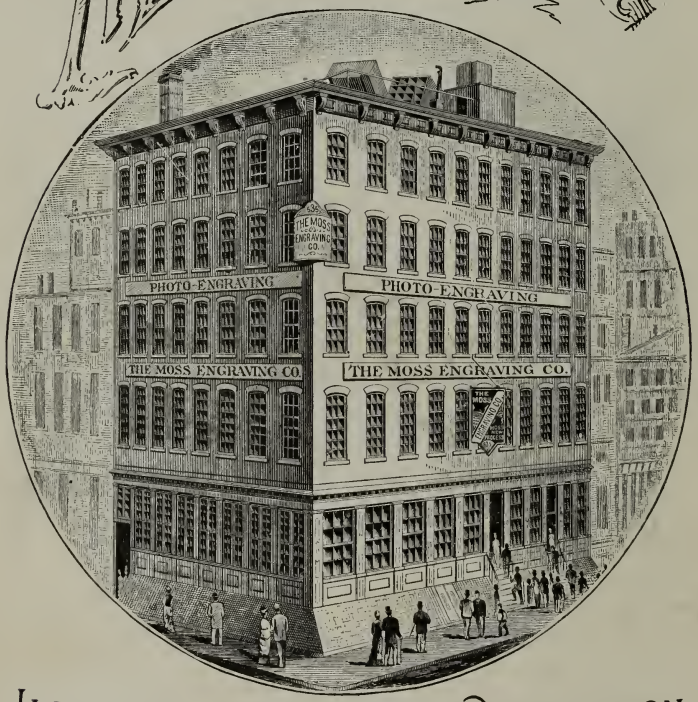

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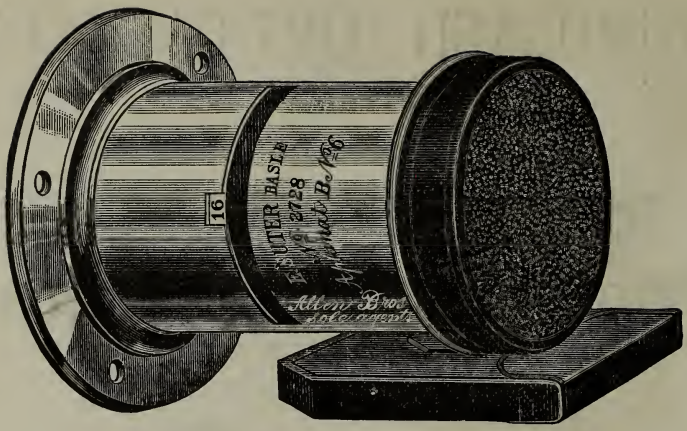

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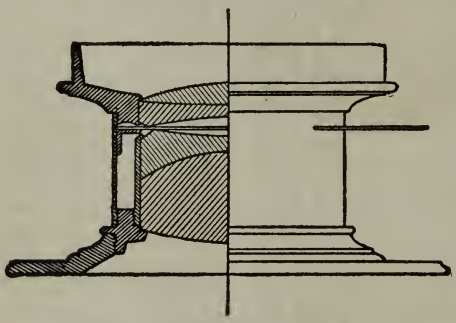

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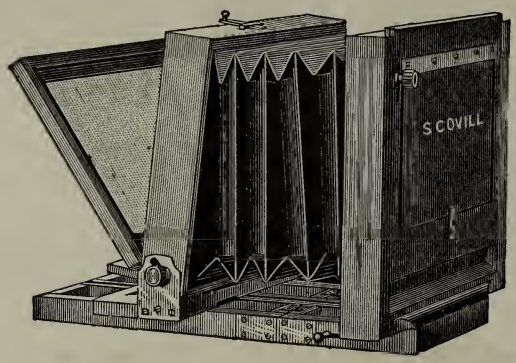

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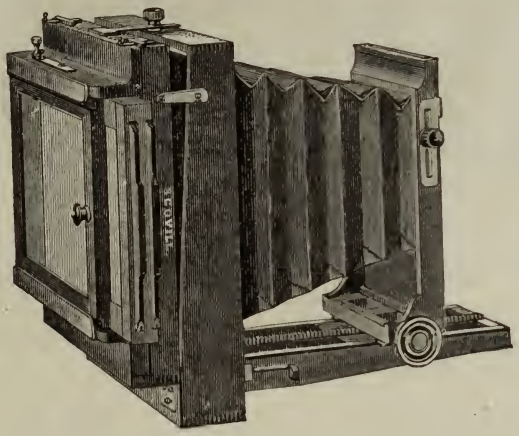

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No. 110—	4 x5	$25 00	$29 00	$35 00	$39 00
" 111—	4¼x5½.....	26 00	30 00	36 00	40 00
" 112—	4¼x6½.....	30 00	34 00	40 00	44 00
" 113—	5 x7	32 00	35 00	44 50	47 50
" 114—	5 x8	34 00	38 00	46 50	50 50
" 115—	6½x8½.....	36 00	40 00	52 00	56 00
" 116—	8 x10	40 00	44 00	60 00	64 00
" 117—	11 x14	60 00	64 00	90 00	94 00

Not made above 11x14 size.

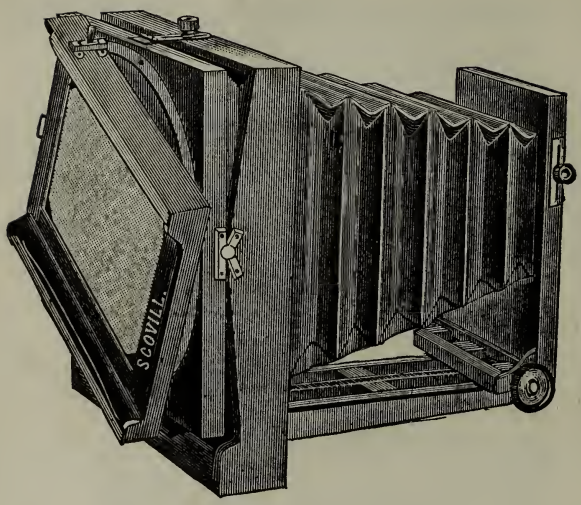
For automatic tally on Roll Holder add $5.00.

Canvas cases to contain Camera with more than one Holder made to order at extra price.

For sale by all dealers in Photographic materials, and by the manufacturers, SCOVILL MANUFACTURING CO.

Revolving-back Camera.

(PATENTED.)



(FRONT FOCUS PATTERN.)

REDUCED PRICE LIST.

Revolving-back Cameras, each incased in a canvas bag, with handle, and above 14x17 size, with two handles.

	REVERSIBLE.				Single Swing.	Double Swing.	With Reversible Back and Holder Extra
No. 120.	For View	4 x 5	in.	.....	$27 00	$32 00	
" 121.	"	4¼x 5½	"	.....	29 00	34 00	
" 122.	"	4¼x 6½	"	.....	31 00	36 00	
" 123.	"	5 x 7	"	.....	33 00	38 00	
" 124.	"	5 x 8	"	.....	35 00	40 00	
" 125.	"	6½x 8½	"	.....	40 00	45 00	
" 126.	"	8 x 10	"	.....	45 00	50 00	
" 127.	"	10 x 12	"	with detachable back.	60 00	65 00	
" 128.	"	11 x 14	"	" "	65 00	70 00	$90 00
" 129.	"	14 x 17	"	" "	75 00	80 00	105 00
" 130.	"	17 x 20	"	" "	85 00	90 00	115 00
" 131.	"	18 x 22	"	" "	95 00	100 00	130 00
" 132.	"	20 x 24	"	" "	115 00	120 00	150 00

These Cameras are fitted with Daisy Dry-plate Holders.

☞ Please state, when ordering any size below 10x12, whether front or back focus is desired.

Revolving-back Cameras, front focus, not made above 8x10 size.

Canvas cases to contain Camera with more than one Holder made to order at extra price.

For sale by all dealers in Photographic materials, and by the manufacturers, SCOVILL MANUFACTURING CO.

Scovill Detective Cameras

Swing Back.—In answer to the popular demand, a Swing Back has been devised for the SCOVILL DETECTIVE CAMERAS, which is simple and effective. It is readily adjusted from the bottom of the case, where all of the outward mechanism of this instrument is placed.

Adapter for Two Lenses.—This devise enables one to use interchangeably, at pleasure, by simply moving the focusing lever, a wide angle and a group lens of quite dissimilar focus. This does away with the necessity of unscrewing the flange of one lens in order to put on the flange belonging to the other lens.

Roll-Holder Detective Cameras.

It followed naturally upon the introduction of the Roll-Holder that it should be applied to the SCOVILL DETECTIVE CAMERA, and this has been done in a manner that displays the greatest ingenuity.

Attached to each is the Patent Automatic Tally, to record the number of exposures made. No Roll-Holder Camera is complete without this.

All of Scovill Detectives are fitted with three Patented Double Dry Plate Lightweight Holders, except where a Roll-Holder is fiitted, and then only one Double Dry Plate Holder is given. We give the prices for all styles of Lenses, but we recommend and guarantee Morrison's and Wale's which are made especially for these boxes.

THE WATERBURY.

SIZE OF PLATE.

4x5.—Two Double Lightweight Holders (patented) and Wale Lens (special)..... $25 00

4x5.—One Patented Roll-Holder, Wale Lens (special)..... 35 00

5x7.—Two Double Lightweight Holders (patented) and Wale Lens (special)..... 40 00

5x7.—One Patented Roll-Holder, Wale Lens (special)..... 58 00

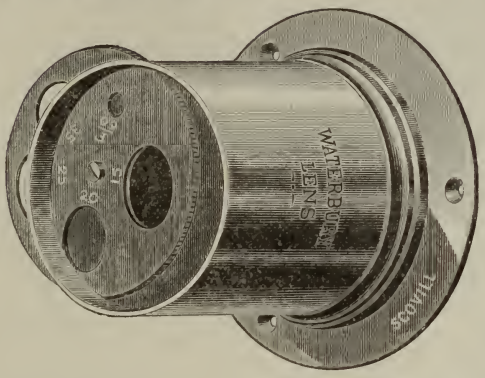
THE SCOVILL.

SIZE OF PLATE. 3¼x4¼	Without Lens.	With Optimus.	With Morrison.	With Beck.	With Ross.	With Automatic tally, roll-holder and only one light-w't holder, add to foregoing prices.
Plain, with 3 Double Light-weight Holders.	$38 00.	46 00.	58 00.	58 00.	65 00	11 00
Swing Back, 3 Double Light-weight Holders.	43 00.	51 00.	63 00.	63 00.	70 00	11 00
Swing Back and Pat. Lens Adjuster and 1 additional Morrison Lens, and 3 Double Light-weight Holders.	78 00.	86 00.	98 00.	98 00.	105 00	11 00
SIZE OF PLATE. 4x5.						
Plain, with 3 Double Light-weight Holders.	55 00.	58 00.	70 00.	75 00.	79 00	13 00
Single Swing and 3 Double Light-weight Holders.	60 00.	63 00.	75 00.	80 00.	84 00	13 00
Single Swing, Pat. Lens Adjuster, 1 additional Morrison Lens, and 3 Double Dry Plate Holders.	95 00.	98 00.	110 00.	115 00.	119 00	13 00
SIZE OF PLATE. 4¼x6½.						
Plain, with 3 Double Light-weight Holders.	65 00.	70 00.	80 00.	85 00.	101 00	13 00
Single Swing and 3 Double Light-weight Holders.	70 00.	75 00.	85 00.	90 00.	106 00	13 00
Single Swing, Pat. Lens Adjuster, 1 additional Morrison Lens and 3 Double Light-weight Holders.	105 00.	110 00.	120 00.	125 00.	141 00	13 00
SIZE OF PLATE. 5x7.						
Plain, with 3 Double Light-weight Holders.	87 00.	95 00.	100 00.	110 00.	121 00	15 00
Single Swing and 3 Double Light-weight Holders.	92 00.	100 00.	105 00.	115 00.	126 00	15 00
Single Swing, Pat. Lens Adjuster and 1 additional Morrison Lens.	127 00.	135 00.	140 00.	150 00.	161 00	15 00

The prices of Light-weight Double Dry Plate Holders (patented) for the above are as follows:

For 3¼x4¼ plates...$1.10. | For 4¼x6½ plates...$1.25.
" 4 x5 " ... 1.25. | " 5 x7 " ... 1.30.

WATERBURY LENSES.



The unprecedented success which has everywhere resulted from the employment of the Waterbury Lenses, for 4 x 5 and 5 x 8 plates respectively, induced the Scovill Mfg. Co. to extend the series of this favorite objective. The popular C Waterbury Lens gave opportunity for producing 8 x 10 and even 10 x 12 photographs with the sharpness, detail and brilliancy of the smaller sizes, but after its advent there was still a gap between the 5 x 8 and 8 x 10 sizes. The desire to see the Waterbury series complete has led to the production of the B B Waterbury Lens, which covers 6½ x 8½ (the ever-popular 4—4 size) to the extreme edges. In future, revolving diaphragms will be supplied with all of the Waterbury Lenses. In them, are cut (with mathematical accuracy) openings in value $F/_{15}$ $F/_{20}$ $F/_{25}$ $F/_{35}$ $F/_{60}$ respectively.

The Waterbury Lenses are composed of a bi-convex crown glass lens cemented to another lens of the plano-convex form, made of the best selected flint glass.

Owing to the great advances in the sensitiveness of emulsion plates, the Waterbury Lenses are now commonly used for groups and for instantaneous views, with the Scovill Safety Shutters, described on another page. No better testimony can be given to the excellence and reliability of these objectives, and the mathematical accuracy with which they are made, than that deduced from the recent test made of 392 lenses of the C series, in which large number only two lenses differed at all in focal length or luminous power from the others.

A, Single, for 4 x 5 plate	$3 50
A, Matched pair, stereoscopic	7 00
B, Single, for 5 x 8 plate	4 50
BB, Single, for 6½ x 8½ plate	6 00
C, Single, for 8 x 10 plate	8 00

For sale by all dealers in Photographic materials, and by the manufacturers, SCOVILL MANUFACTURING CO.

AMERICAN LENSES.

Morrison's Wide-Angle View Lenses.

Patented May 21, 1872.

These Lenses are absolutely rectilinear; they embrace an angle of fully 100 degrees, and are the most rapid, and are universally conceded to be the best *wide-angle* lenses made.

No.	Diameter of Lens.	Size of Plate.	Equivalent Focus.	Price.	
1....	¾ inch..	3¼ x 4¼ inch....	3 inch, each,	$25 00	
2....	1 " ..	4 x 5 " ..	3½ " "	25 00	
3....	1 " ..	4½ x 7½ " ..	4¼ " "	25 00	These 5 sizes will fit into 1 flange.
4....	1 " ..	5 x 8 " ..	5¼ " "	25 00	
5....	1 " ..	6½ x 8½ " ..	6½ " "	25 00	
6....	1 " ..	8 x 10 " ..	8 " "	30 00	
7....	1¼ " ..	11 x 14 " ..	10½ " "	40 00	These 2 sizes will fit into 1 flange.
8....	1¼ " ..	14 x 17 " ..	14 " "	50 00	
9....	1½ " ..	17 x 20 " ..	17 " "	60 00	These 3 sizes will fit into 1 flange.
10....	1½ " ..	20 x 24 " ..	22 " "	80 00	
11....	1½ " ..	25 x 30 " ..	28 " "	100 00	

☞ Nos. 1 to 6 are all made in matched pairs for stereoscopic work. The shorter focused Lenses are especially adapted for street and other views in confined situations. For general purposes, a pair of No. 5 Lenses will be found most useful.

Morrison Combination Wide-Angle Lens.

Opening the velvet-lined morocco case containing this lens you will find partitioned-off space containing an ordinary 5-inch Morrison Wide-Angle Lens, on which the front and back combinations are distinctly marked with the figure 5.

Besides this, in cells, are four mountings with lenses of varying focal lengths, each marked in white with a number. By unscrewing the back combination marked 5, and putting in its place the mounting marked 6, a lens of 6-inch back focus is obtained.

Again, by removing both these cells and replacing them with the two marked 8, a lens of 8-inch back focus is the result.

By screwing in the front combination marked 5 and the back combination marked 4, a lens of 4-inch back focus is obtained.

Putting a front combination marked 8 and a back marked 6, a focus of 7 inches is produced.

Thus the operator has a choice of five focal lengths with the one lens.

No. 1 Morrison Combination Wide-Angle Lens..... ...$80.00
No. 2 " " " " 55.00

Making 4, 5, and 6-inch lenses.

Morrison Instantaneous Wide-Angle View Lenses.

With full opening, these Lenses have all the extreme depth for which the Morrison Regular Wide-Angle Lenses are noted. They work with extreme rapidity, and will cover an angle of 90 degrees sharp. Furnished with a set of diaphragms.

Diameter of Lens.	Size of Plate, Full Opening.	Size of Plate when Stopped Down.	Focus.	Price.
⅞ in h.	4x 4 inches.	5x 7 inches.	6 inches.	$30 00
1 "	4x 5 "	8x10 "	8 "	35 00
1¼ "	5x 8 "	10x12 "	10 "	40 00
1⅝ "	8x10 "	14x17 "	12 "	45 00

For sale by all dealers in Photographic materials, and by the manufacturers, SCOVILL MANUFACTURING CO.

Scovill Time and Instantaneous Shutter.

That the substitution of a pneumatic release for the ordinary trigger on a wood drop-shutter greatly enhances its value, "goes without saying."

The Scovill Time and Instantaneous Shutter

Is Fitted with Pneumatic Attachment,

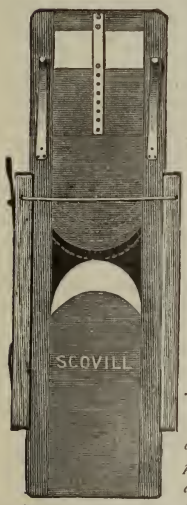
which may be worked at a considerable distance from the Camera, thus enabling the operator to form part of a group or to be included in a view he is photographing. This Shutter may be used for either timed or instantaneous exposures; the change is made by simply moving a switch.

Scovill Safety Shutter, with Time and Instantaneous Attachment.

SCOVILL UNIVERSAL SAFETY SHUTTERS.

This Shutter is styled Universal, not only because more of the Scovill Safety Shutters are in use than of any other pattern, but because it can be arranged with a variety of openings, from ¼ to 2 inches at the center, as shown by the dotted lines of the accompanying illustration. Uniform distribution of light over the plate is insured by the form of opening.

The brakes on all of these Shutters make them safe to use, by preventing a recoil with the resulting double exposure, and the jarring common to many Shutters, which in time breaks apart the glasses of a Lens where cemented together—hence the designation "Safety Shutters"

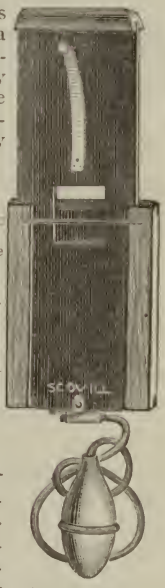


Scovill Universal Shutter.

PRICE LIST.

No.	Width of Opening in Slide.	Scovill Universal Shutters.	Universal Shutters, with Pneumatic Release.	Scovill Safety Shutters.	Safety Shutters, with Pneumatic Release.	Universal Time and Instantaneous Shutter with Pneumatic Release.
1	1¼ ins.	$2.70	$4.20	$1.20	$2.70	$4.70
2	1½ "	2.80	4 30	1.30	2.80	4.80
3	1¾ "	2.90	4.40	1.40	2.90	4.90
4	2 "	3.00	4.50	1.50	3.00	5.00
5	2½ "	3.10	4.60	1.60	3.10	5.10
6	3 "	3.25	4.75	1.75	3 25	5.25

When ordering these Shutters, exact diameter of hood of Lens should be given, so that the proper circular opening may be cut out to exactly fit hood of Lens. If not stated, the Shutters will be sent without the round opening being cut.



Scovill Safety Shutter.

SCOVILL'S

Ready Sensitized Albumen Paper.

This Paper was expressly manufactured for and introduced by us to give to those who have not the skill, time, inclination or appliances to sensitize photographic paper preparatory to printing, an article of the finest quality and of uniform sensitiveness.

PRICE LIST.

Size.						Per Package.
4x 5	inches,	in light-tight	packages,	2	dozen	$0 40
5x 8	"	"	"	2	"	75
6¼x8½	"	"	"	2	"	1 00
8x10	"	"	"	2	"	1 50
18x22	"	"	"	1	"	per doz. 3 00

To save loss, rolls are not broken.

TIN CASES to hold one dozen 18x22 Sensitized Paper, 30 cents each.
" " three " " " " 50 "

S. P. C.

FERRO-PRUSSIATE PAPER,

For Making Blue and White Pictures.

Our brand **S. P. C.** is a sure index of superiority in texture, the paper is better wrapped than any other, and is noticeably free from spots streaks or flaws.

This paper is extremely simple in its manipulation, and therefore very convenient for making proofs from negatives. It is also adapted for the reproduction of *Mottoes*, *Plans*, *Drawings*, *Manuscript*, *Circulars*, and to show representations of Scenery, Boats, Machinery, &c., for an engraver to copy from. The rapidity with which a print can be made with this paper is for numerous purposes, and to men in some occupations, a very great recommendation in its favor.

PRICE LIST.

Size.						Per Package.
4 x 5	inches,	in 2 dozen	light-tight	parcels		$0 28
5 x 8	"	2	"	"		50
6½x 8½	"	2	"	"		67
8 x10	"	2	"	"		83

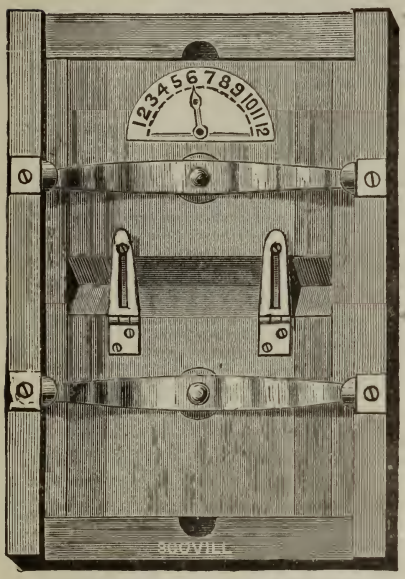
To save loss, parcels are not broken.

In full rolls of 11 yards each, 29 inches wide, $3.50 per roll.

IRVING PRINTING FRAMES

(PATENTED.)

The IRVING FRAMES have valuable features which cannot be copied. They are in workmanship, design, and other respects, superior to all other printing frames.



IRVING PRINTING FRAME, CLOSED
FRONT VIEW.

IRVING PRINTING FRAME, OPEN.
BACK VIEW.

The continuous felt pads made especially to order for us, insure absolute protection and uniform pressure throughout. The Irving Patent Catches lock the back, so that when one flap is open there is not the slightest danger of the flaps, paper or negative slipping.

The springs are cut by dies of specially tempered and tested metal, and are riveted to the backs with washers underneath to protect the woodwork.

The IRVING FRAMES are made of cherry guaranteed not to warp or crack. Their construction and finish is acknowledged to be superior to that of all other printing frames.

The tally does not depend upon any other part of the frame to lock it, for the pointer will remain in place no matter what is done to other parts of the frame.

Prices for Half or Two-thirds Opening Styles.

3¼ x 4¼	$ .45	6½ x 8½	$ .70
4 x 5	.48	8 x 10	.80
4¼ x 5½	.50	10 x 12	1.10
4¼ x 6½	.55	11 x 14	2.10
5 x 7	.60	13 x 16	2.30
5 x 8	.65	14 x 17	2.70

When made with backs to open lengthways, ten per cent. is added to the foregoing prices, for the respective sizes.

"The American Annual of Photography and Photographic Times Almanac"

o——————**FOR 1888.**——————o

C. W. CANFIELD, Editor.

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"It is a striking volume full of photographic exercises, and excellent illustrations."—*New York Sun.*

"It fully keeps up to the record of this firm in its endeavor to give to professional and amateur photographers a complete compendium of the art of photography."—*The New Bedford Evening Standard.*

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"It is a neat volume, full of useful articles, tables, formulæ, etc."—*St. Louis Photographer.*

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By mail, 10c. additional.

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SCOVILL MANUFACTURING COMPANY.

THE

American Annual of Photography

AND

"Photographic Times" Almanac

For 1887.

C. W. CANFIELD, Editor.

A STANDARD BOOK OF REFERENCE.

It contains five full-page illustrations:

AN EXQUISITE PHOTO-GRAVURE, by Ernest Edwards.
A BROMIDE PRINT, by the Eastman Company.
A SILVER PRINT, by Gustav Cramer, of St. Louis.
TWO MOSS TYPES, by the Moss Engraving Company.

197 pages of **Contributed Matter,** consisting of articles on various subjects, by 80 representative Photographic writers of this country and Europe.

Also, in addition to the contributed articles:—Yearly Calendar. Eclipses, the Seasons. Church Days, Holidays, etc. Monthly Calendar, giving Sunrise and Sunset for every day in the year; Moon's phases; also, dates of meetings of all American Photographic Societies. A list of American and European Photographic Societies. Photographic Periodicals, American and European. Books relating to Photography, published 1886. Approved Standard Formulæ for all processes now in general use. Tables of Weights and Measures. American and Foreign Money Values. Comparisons of Thermometric Readings. Comparisons of Barometric Readings. Symbols and Atomicity of the Chemical Elements. Symbols, chemical and common names and solubilities of the substances used in Photography. Tables for Enlargements and Reductions. Equations relating to Foci. Tables of Comparative Exposures. Freezing Mixtures. Photographic Patents issued 1886. Postage Rates. All Tables, Formulæ, etc., brought down to date and especially prepared or revised for this work.

Price, per Copy, 50 Cents. By mail, 10c. extra.
Library Edition, $1.00. " "

For sale by all dealers in photographic materials, and by the publishers,

SCOVILL MANUFACTURING COMPANY.

THE PHOTOGRAPHIC TIMES

—FOR—

December 23, 1887,

—IS A—

DOUBLE ILLUSTRATED HOLIDAY NUMBER

OF UNUSUAL INTEREST AND VALUE.

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And containing a full-page Portrait of the Author, with a Biographical Sketch.

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A PRACTICAL GUIDE TO THE PROFESSIONAL AND AMATEUR WORKER.

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It is a volume of more than 200 pages, uniform in size of page and type with "THE PHOTOGRAPHIC NEGATIVE" and the other numbers of the Scovill Photo. Series; is neatly bound in cloth, with gilt titling; and both inside and out makes a most attractive appearance.

Treating as it does of a field in photographic literature so long neglected, and one which is so important to all practical photographers, this book is almost indispensible. It is the only book in photographic literature to-day, which covers this ground, and it does so completely.

The chapters which it contains on the following subjects, give an idea of its completeness and practical value:

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CHAPTER II.—THE SILVER BATH.
CHAPTER III.—FUMING AND PRINTING.
CHAPTER IV.—TONING AND FIXING—WASHING.
CHAPTER V.—PRINTING ON OTHER THAN ALBUMEN PAPER.
CHAPTER VI.—THE PLATINOTYPE.
CHAPTER VII.—PRINTING WITH EMULSIONS.
CHAPTER VIII.—MOUNTING THE PRINTS.
CHAPTER IX.—CARBON PRINTING.
CHAPTER X.—PRINTING ON FABRICS
CHAPTER XI.—ENLARGEMENTS.
CHAPTER XII.—TRANSPARENCIES AND LANTERN SLIDES.
CHAPTER XIII.—OPAL AND PORCELAIN PRINTING.
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CHAPTER XV.—PHOTO-MECHANICAL PRINTING METHODS.
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The Rev. W. H. BURBANK,

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